Packed with Special Christmas Features

NEWNES

# PRACTICAL MECHANICS

DECEMBER 1938

6D.

*CONTENTS*

CHRISTMAS PARTY CONJURING

MAKING A SINGING ROBOT

RADIO TRICKS AND GAMES

HOME BROADCASTING

THE LATEST IN MODEL RAILWAYS

AN INGENIOUS ELECTRICAL GAME

*AND*

ALL THE REGULAR FEATURES

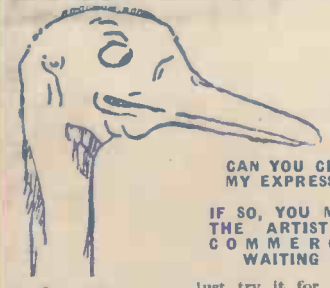
# LET ME HELP YOU INTO A KEY POSITION

## DO ANY OF THESE SUBJECTS INTEREST YOU?

Accountancy Examinations
Advertising and Sales Management
A. M. I. Fire E. Examination
Applied Mechanics
Army Certificates
Auctioneers and Estate Agents
Aviation Engineering
Banking
Boilers
Book-keeping, Accountancy and Modern Business Methods
B.Sc. (Eng.)
B.Sc. (Estate Management)
Building, Architecture, and Clerk of Works
Builders' Quantities
Cambridge Senior School Certificate
Civil Engineering
Civil Service
All Commercial Subjects
Commercial Art
Concrete and Structural Engineering
Draughtsmanship, All branches
Engineering, All branches, subjects and examinations
General Education
G.P.O. Eng. Dept.
Heating and Ventilating
Industrial Chemistry
Insurance
Journalism
Mathematics
Matriculation
Metallurgy
Mining. All subjects
Mining, Electrical Engineering
Motor Engineering
Motor Trade
Municipal and County Engineer
Naval Architecture
Novel Writing
Pattern Making
Play Writing
Police, Special Course
Preceptors, College of
Press Tool Work
Pumps and Pumping Machinery
Radio Communication
Radio Service Engineering
Road Making and Maintenance
Salesmanship, I.S.M.A.
Sanitation
Secretarial Exams.
Sheet Metal Work
Shipbuilding
Shorthand (Pitman's)
Short Story Writing
Structural Engineering
Surveying
Teachers of Handicrafts
Telephony and Telegraphy
Transport Inst. Exams.
Weights and Measures Inspector
Welding
Wireless Telegraphy and Telephony
Works Managers

*If you do not see your own requirements above, write to us on any subject. Full particulars free.*

## STUDY AT HOME IN YOUR SPARE TIME



CAN YOU CHANGE MY EXPRESSION?

IF SO, YOU MAY BE THE ARTIST THAT COMMERCE IS WAITING FOR

Just try it for yourself. Trace or draw the outline and then put in the features.

**There are hundreds of openings in connection with Humorous Papers, Advertisement Drawing, Posters, Calendars, Catalogues, Textile Designs, Book Illustrations, etc.**

60 per cent. of Commercial Art Work is done by "Free Lance Artists" who do their work at home and sell it to the highest bidders. Many Commercial Artists draw "retaining fees" from various sources, others prefer to work full-time employment or partnership arrangement. We teach you not only how to draw what is wanted, but how to make buyers want what you draw. Many of our students who originally took up Commercial Art as a hobby have since turned it into a full-time paying profession with studio and staff of assistant artists; there is no limit to the possibilities. Let us send full particulars for a FREE TRIAL and details of our course for your inspection. You will be under no obligation whatever.

Jim Duck

**ART DEPT. 76.**

## YOU CANNOT MAKE MONEY BY SAVING

If you save 10s. per week for 10 years you have only got £260, but if you spend 2s. 6d. per week for 12 or 18 months on a correspondence course, you give your brains a chance to earn thousands of pounds; then there is no need to save.

Savings are likely to vanish, but earning capacity is a permanent investment.

## I HAVE HELPED THOUSANDS OF OTHERS

And when I say thousands, I do not exaggerate, as I can produce well over 10,000 unsolicited testimonials from grateful students who, through our Postal Training, have achieved their life's ambition.

J. H. Bennett


**Dept. 76, THE BENNETT COLLEGE, SHEFFIELD**

## EVERY DEPARTMENT IS A COMPLETE COLLEGE: EVERY STUDENT IS A CLASS TO HIMSELF

### JOURNALISM
### Short Story, Novel and Play Writing

There is money and pleasure in Journalism and in Story Writing. No apprenticeship, no pupilage, no examinations, no outfit necessary. Writing for newspapers, novels or pictures is not a gift; it is a science that can be acquired by diligent application and proper guidance. It is the most fascinating way of making pastime profitable. Trained ability only is required; we do the training by post. Let us tell you all about it.

**DEPARTMENT OF LITERATURE 76**

**If you attend to this now, it may make a wonderful difference to your future.**

**COUPON—**

CUT THIS OUT

**To Dept. 76, THE BENNETT COLLEGE LTD., SHEFFIELD**
Please send me (free of charge)
Particulars of.....
Your private advice about
(Cross out line which does not apply)

.....

.....

.....

.....

PLEASE WRITE IN BLOCK LETTERS

Name.....

Address.....

.....

.....

SUBSCRIPTION RATES
Inland and Abroad 7s. 6d. per annum
Canada - - 7s. per annum

Editorial and Advertisement Offices: "Practical Mechanics," George Newnes Ltd.
Tower House, Southampton Street, Strand, W.C.2.
'Phone: Temple Bar 4363.
Telegrams: Newnes, Rand; London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.



# PRACTICAL MECHANICS

Editor : F. J. CAMM

VOL. VI. DECEMBER, 1938 No. 63

## Fair Comment

### By The Editor

**Seasonal Greetings**

ALTHOUGH this issue is on sale a few weeks before the festive 25th, its presentation is a reminder that Christmas and the happy thoughts and jolly occasions which go with it is near at hand, and I want specially to extend sincere greetings to those many thousands of readers at home and overseas whom I count as my friends as well as readers, and particularly to our British friends overseas to whom Christmas is at once a joyous occasion and an occasion of yearning for the good things which the Mother country offers at such a time. I send my good wishes to every reader and I wish also to use this opportunity to say how much I appreciate the letters, both constructive and critical, which they send to me from time to time.

The loyal band of contributors who serve this journal join me in those cordial greetings, and we dedicate anew our service to you.

There are many special features in this issue designed to appeal to those who wish to turn their mechanical skill to advantage in planning a party that is somewhat different from the old-fashioned party of a few years ago.

Our Christmas Number marks the end of the year, but not the end of our volume, for the volume commences with the October issue each year. Many new features are planned for 1939.

**Curious Inventors**

THERE are many genuine inventors whose education and training, plus their business ability, make them successful. There is another type of inventor, however, who produces some trifling thing and imagines that he could make a fortune out of it. It is this type which is largely responsible for the popular opinion that inventors seldom make money out of their inventions. There is also a popular conception that an inventor has a mental capacity far beyond that possessed by normal people, and those of us whose job it is to deal with them know this to be untrue.

Now invention, using the true meaning of the word, implies the creation of an original idea and the ability to put it into practice successfully. It is the highest of the faculties, and as such it should be encouraged as it is in other countries by the State. There are occasions when a great idea has been evolved by a comparatively uneducated and untrained man, but the occasions are rare. Very few of them have appreciated the importance of their invention and become disgruntled when, having sold it for a few pounds, some live commercial individual takes over the invention and makes money out of it. The trifling inventions so-called are, if novel and containing a sufficient degree of invention, protected by the Patent Acts equally with the intricate inventions, such as the linotype or the automatic pilot.

It is unfortunately the case that commercial interests enter into the profits side of invention, for however valuable an invention may be from a scientific point of view, if it does not fulfil a need or if it merely does in a more complicated way something which has already been satisfactorily performed by simpler apparatus, if it cannot be made commercially, and if public demand is against it, the invention is doomed to failure.

A live inventor is the man who discovers the need and proceeds to supply it. He is a man who knows where to sell his ideas. I mention these points because I often receive letters containing ideas for patents and many of them end up by asking me where the idea can be disposed of. In a large number of cases we advise the inventor to take out a patent and in others we do not advise further procedure.

Before an invention can be sold it is absolutely necessary to patent it before you approach manufacturers. In the first place, if you do not do so, disclosure to a third party may invalidate your claim to a patent, and secondly, the possession of the patent sets a seal on your proprietorial rights to the idea. The people whom you approach will in many cases not know you and they are entitled to presume that the idea is not yours, or at least to doubt your rights to it unless you can prove it, and a patent is the only proof.

Some readers give the merest outline of their idea and ask whether it is patentable. We require fullest particulars before advice can be given.

**Give Books This Christmas!**

A BOOK is an enduring gift, and unlike so many of the transitory gifts which are made at this time of the year, its value endures for years. There are many books in our technical list which your friends would value.

There is the new "Practical Mechanics Handbook" (bookstall edition), attractively bound in green cloth and consisting of 400 pages, at 6s.; the new "Workshop Calculations, Tables and Formulae," 3s. 6d.; the "Home Mechanics Encyclopaedia," at 3s. 6d.; the "Model Aircraft Book," at 5s.; "Hobbies New Annual," at 5s.; "The Practical Wireless Service Manual," 5s.; "The Wireless Constructor's Encyclopaedia," 5s.; "Television and Short-wave Handbook," 3s. 6d.; "Wireless Coils, Chokes and Transformers," 2s. 6d.; "Wireless Transmission for Amateurs," 2s. 6d.; "Everyman's Wireless Book," 3s. 6d.; "Sixty Tested Wireless Circuits," 2s. 6d.; and, of course, the well-known "Home Mechanic" series at 1s. each. Postage extra in each case.

**"Practical Leatherwork and Allied Crafts"**

WE have just added a new title to the "Home Mechanic" series —"Practical Leatherwork and Allied Crafts," at 1s. (by post, 1s. 2d.). It deals with all of the various branches of home leatherwork and has additional chapters on Gesso, Raffia, Batik, Beadwork, Stencilling, Rug Making, Lampshade Making, Handbag Making, Plaiting and Weaving, Thonging, Staining, Appliqué, etc.

# Conjuring Tricks You Can Perform

*Fig. 8.—Vanishing a shilling. A halfpenny is concealed in the corner hem of a handkerchief and sewn in. When the shilling is seemingly wrapped in the handkerchief it is this prepared corner which is wrapped, the shilling being secretly removed.*

*Some Simple Tricks for the Festive Season which may be performed without special apparatus*

By Norman Hunter
(The Well-known Conjurer of "Maskelyne's Mysteries")

THE first trick is performed with three matchboxes, two empty and one containing a few matches. The boxes are shuffled together and spread out on the table. The conjurer is able to tell instantly which box contains the matches, yet when a member of the audience tries his hand he is always wrong.

The secret is surprisingly simple. To begin with all three boxes are empty but the conjurer has another box, containing some matches, concealed in his right hand. He shakes the first two boxes with his left hand to prove them empty but the third one he picks up with his right hand in which the extra box is concealed. Shaking this box causes the matches in the hidden box to rattle and so convey the impression that the visible box contains matches. (See Fig. 1).

This simple secret is the basis of the whole trick. The boxes can be shuffled round and laid out in any order, but the conjurer can of course make any of them appear to be full or empty by picking it up with the left or right hand as the case may be. Members of the audience can indicate their choice when, of course, the conjurer will make it incorrect or they can be invited to pick out the full box themselves and naturally they will always fail.

**"Second Sight"**

A variation of the trick consists in having matches in one of the boxes and letting members of the audience shuffle them while your back is turned. You undertake to pick out the full box every time, which of course you are apparently able to do by means of the concealed box in your hand.

To follow this trick here is a kind of second sight effect. It can be done with one of the matchboxes used in the last item, or with a packet of cigarettes.

The box and contents are handed to the audience with the request that a certain number of cigarettes be put into the box and the box left on the table. While this is done the conjurer goes out of the room. Immediately he returns he asks someone to think of the number of cigarettes in the box, looks straight at them and tells the number correctly.

For this trick you need an assistant. It does not matter whether the audience know that he is assisting you or whether he is a secret confederate. All he has to do is to take the box with the cigarettes in it and put it on the table. He, of course, knows the number and he communicates it to you by the position in which the box is placed.

Using a packet of ten cigarettes, the box is placed near one of the four corners of the table to indicate one, two, three or four cigarettes and in the centre to show five. The remaining five numbers are indicated with the same positions, but with the packet upside down, that is to say with the front of the box facing downwards. Fig. 2 will make the code clear. Needless to say the packet should not be placed too close to the corner of the table, neither should the trick be repeated too often or someone in the audience may get a clue to the secret.

*Fig. 1.—Making an empty matchbox seem full by rattling another box containing matches which is concealed in the hand.*

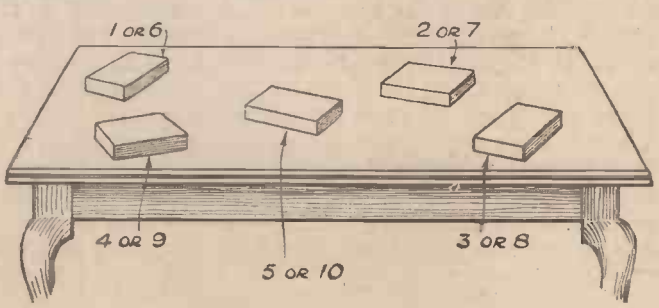



*Fig. 2.—Code for placing box to show number of cigarettes it contains.*

**The "Magnetic" Stick**

For the next experiment you use a walking stick or a rolled umbrella. You rub it briskly with your hands which seems to have a magnetic effect upon it for it can then be made to cling to the tips of your fingers without visible support.

A length of fine black cotton is the secret of this trick. An endless loop of it is attached to one of the buttons of your waistcoat. Having obtained the stick, which should preferably be of dark colour, you secure the free end of the loop in your right hand and secretly pass it over the stick. By placing the fingers on either side of the loop and pressing outwards against the stick you can make the stick adhere to your hand in a variety of apparently impossible positions. Fig. 3 demonstrates the method and I have used string in place of thread to make the working clear. At the finish of the demonstration the cotton may be snapped and dropped on the carpet.

Producing a lot of things from an empty hat is always a good conjuring trick and it is not at all difficult to do if you use this method:

First make a neat parcel of the things you are going to produce: paper garlands, silk handkerchiefs, etc., by wrapping them in a square of black material. Fold the four corners of the material together and fasten them with a spring clip as shown in Fig. 4. The parcel so formed should be small enough to go easily into the hat. Now fix a loop of fine wire to the clip, twisting it firmly so that it will stand up by itself. Drive a gramophone needle into the back of the table and hang the parcel on it by one of the holes in the clip, leaving the wire loop sticking up over the table edge.

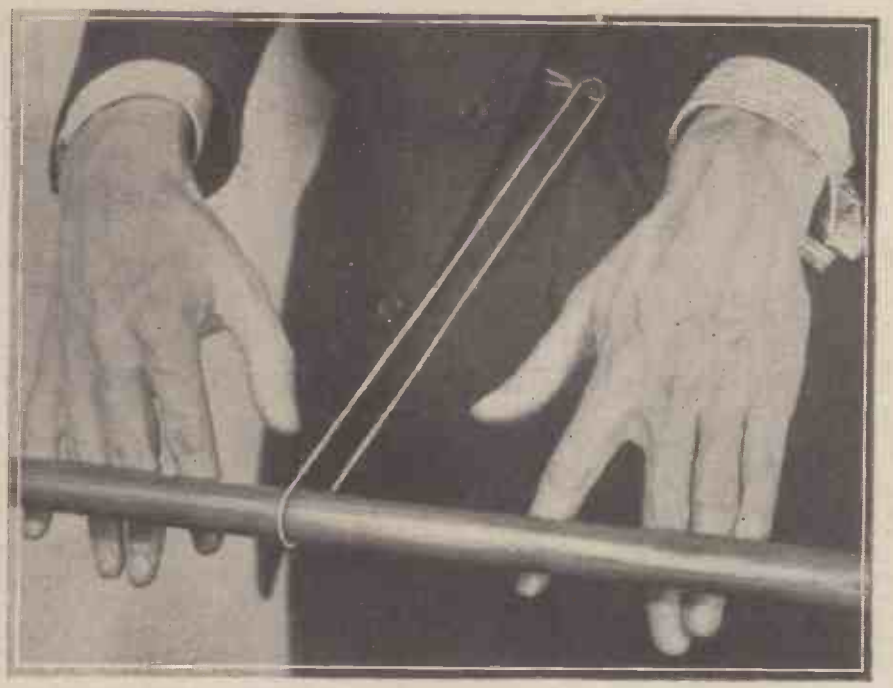


*Fig. 3.—"Hypnotising" a walking-stick. A loop of black thread, shown here by string, attached to the waistcoat button forms the invisible support.*

**Loading the Hat**

Having shown the hat empty, place it crown upwards on the table, near the back. Turn your sleeves up, then pick the hat up again. In doing this you pick up the hat by the brim with your fingers underneath and you will find that you can slip one finger through the wire loop. Turn the crown of the hat towards the audience as you pick it up and the parcel will drop neatly and invisibly inside. All you have then to do is press open the clip and produce the articles. Fig. 5 will explain the movements more fully.

Another way of loading a hat which sounds very audacious, but which I have used myself for years, is as follows :—

Have the parcel, a fairly small one, already in the hat. Pick up the hat with your left hand and hold it with the crown towards the audience, then hang it over your right hand while you draw attention to the fact that there are no holes in the hat on that side. Now remove your right hand, taking with it the load and hold it behind your back while you turn the hat over, mouth towards the audience and point out that there is one hole on that side, for getting the head in. Turn the hat over again, bring your right hand round behind it, deliberately put the load back in the hat and take the hat away with the right hand to put it on the table. The mere act of showing that the hat is empty serves to cover the introduction of the load. Fig. 6 shows one stage of the trick.

*Fig. 5.—Bringing the load into the hat from behind the table.*

**A Card Trick**

Now for a card trick of a rather unusual type. This one has the advantage of being easy and quick. Long-drawn-out card tricks always tend to be boring even when performed by an expert.

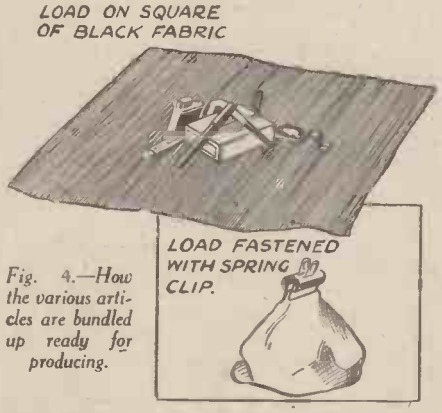



*Fig. 4.—How the various articles are bundled up ready for producing.*

A pack of cards is shuffled and one card quite freely chosen. The card is replaced in the pack and you announce that you will find the chosen card. This you explain is quite easy because the card feels so superior at having been chosen that it will turn its back on the others. You spread the cards out on the table, face down, and the audience see that one card among them is facing upwards. This proves to be the card selected.

All you need for this trick is a pack of cards with a white border round the design on the back. Most packs have this so that should not prove a difficulty.

Begin the trick by having the bottom card turned over to face the rest of the cards. This will not be noticeable as you fan the cards slightly to have one taken. While the chooser is memorising the card you secretly turn the pack over. If you like you can turn your back to do this under pretence of not wanting to see the card while it is shown to the rest of the audience. This will also give you an opportunity to reverse the bottom card so that you need not have it reversed to begin with. Hold the pack firmly as the card is returned. You can spread the cards a little because the white edges of the cards facing upwards under the reversed top one will simply look like the white edges of the backs. As soon as the card has been returned, as shown in Fig. 7, which gives an exposed view, square up the pack and turn the bottom card over again as you go to the table. Spread out the cards with the faces downwards when of course the chosen card, which was put back the opposite way unknown to the audience, will now be facing upwards.

Conjurers are proverbial borrowers so here is a trick with somebody's shilling. Having borrowed the coin and had it marked by the owner you wrap it in a handkerchief and give it to someone to hold. You then go behind your screen and bring out a tray with a number of small boxes. They may be empty matchboxes or little cardboard pill boxes. One of the boxes is chosen by the person who lent the shilling and he is given this box to hold.

You now snatch away the handkerchief, shake it out and show that the coin has vanished. The person holding the chosen box opens it and finds his marked shilling inside.

**The Secret**

There are two secrets to this trick. The first is the vanish of the shilling. Fig. 8 shows an ordinary handkerchief with a halfpenny being concealed in the corner hem. Sew the opening of the hem across to keep the coin in. Having borrowed the shilling, hold it and the prepared corner of the handkerchief in your right hand. Now apparently wrap the coin in the folds of the handkerchief. What you actually do is to wrap up the prepared corner with the halfpenny in it. Give the handkerchief to someone to hold, asking them to grip the coin firmly through the handkerchief. Of course the concealed halfpenny feels like the shilling they imagine to be wrapped in the handkerchief. (See Fig. 9.) You bring away the marked shilling concealed in your hand.

Behind your screen are twelve boxes, one open. Into this open box you place the marked shilling, close it and bring out all the boxes. You spread them on the table in two rows, six in each row, noting in

*Fig. 6.—Loading a hat. A side view showing the load being brought from behind the back into the hat, the entire movement being hidden by the hat itself.*

which row the box containing the shilling is placed. You begin by asking the owner of the coin to choose front row or back row. Whatever he says you can interpret his choice to fall on the row containing the box with the coin. If he says front row you can take this as meaning the front row as seen by him or the front row as seen by you, and similarly if he says back row.

**"Forcing" the Box**

Leaving this row of boxes you place the others aside. Now divide these six boxes into two groups of three, one at your right and one at your left and ask him to choose again. Once more you force the group containing the right box by taking his "right" or "left" to mean right or left as seen by him or as seen by you. This leaves you with three boxes. See that the one containing the coin is in the middle and again ask him to indicate a box. If he chooses the centre one just give it to him to hold. If he chooses one of the side boxes put it aside and ask him to choose again. This time if he chooses the right box give it to him, but if he indicates the empty box say "That disposes of that" and give him the one left. Thus you will see that by interpreting his choice to suit yourself you gradually narrow his selection down to the box containing his shilling. (See Fig. 10.)

To finish the trick, snatch the handkerchief from the hand of the person holding it and shake it out when, of course, nothing will fall out as the concealed coin is safely sewn into the corner. It only remains to ask the owner of the shilling to open the box and let him find his marked coin inside.

The whole point of the trick is the fact that the box is chosen while the shilling is apparently being securely held by a member of the audience.

**Remarkable Cards**

Another card trick, this time a feat of impossible juggling. You lay a card on your hand and place a number of other cards round it star fashion. You then turn your hand over so that the palm is downwards but the cards do not fall. They remain apparently stuck to your hand until you tell them to drop, when they all flutter to the floor.

One card is specially prepared for this trick as shown in Fig. 11. Cut a disc about the size of a penny from another card of the

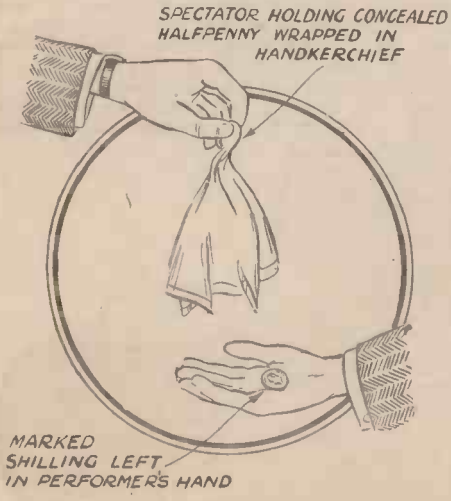



*Fig. 9.—Give the handkerchief to someone to hold, asking them to grip the coin firmly through the handkerchief.*

same pattern, score it across the centre and stick one half firmly to the back of one of the cards in the pack. If you can use a pack that has a circle in the centre of the

*Fig. 7.—The reversing card. Exposed view showing bottom card of pack reversed and entire pack turned face upwards so that the chosen card is returned facing the opposite way to the others*

pattern this will of course help to disguise the presence of the little tab.

To perform the trick pick up the prepared card apparently casually, secretly

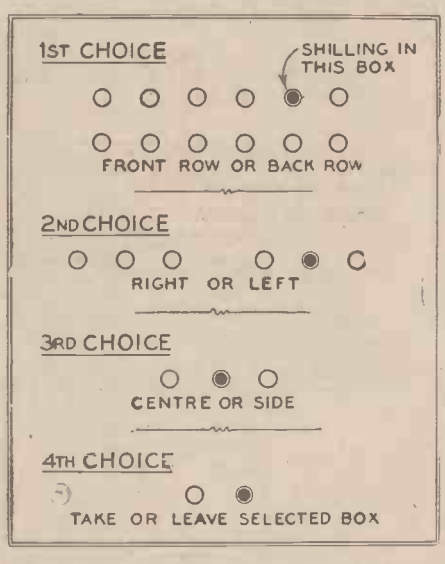



*Fig. 10.—How the boxes are arranged ready for "forcing."*

bend up the un-stuck half of the little circle and place the card face upwards on your hand. You will then find you can grip the tab securely between two of your fingers. In placing the other cards round the first tuck them underneath the faked card.

You will now find that by turning your hand over quickly none of the cards will fall, the tab on the faked card holding them all securely in place. You can even wave your hand about with the star of cards apparently adhering to it. When you want the cards to fall simply relax the grip of your fingers on the tab and they will all flutter to the floor.

Finally here is a good showy trick to finish up with. You begin by showing a square chimney about a foot high and four inches across. You hold it up so that the audience can see right through. It is obviously empty. You stand the chimney on a thin tray and drop in a few pieces of red, white and blue paper. Then giving the chimney a tap with your wand you reach in and produce a large union jack.

The entire secret is in the chimney. It may be made of thin wood or stout cardboard. As you will see from Fig. 11, which gives a sectional view of it, the chimney has a sloping inner partition along one side. This partition comes out flush with the edge of the chimney at one end, but projects inwards about an inch at the other end. The union jack, is packed into the space between the partition and the side of the chimney, leaving two corners easily get-at-able at the top.

To show the chimney empty, hold it up with the closed end of the partition towards the audience and look through it at them. The sloping side of the partition will be taken to be the side of the chimney seen in perspective and as long as you do not hold it up too long there is no risk of the audience detecting the fact that it is not empty. Incidentally it makes for a better illusion if instead of being square the chimney is rectangular in shape, having two sides rather longer than the other two.

The working of the trick should now be clear. Show the chimney empty then stand it on a tray with the open end of the secret compartment uppermost. Tear up some pieces of paper and drop them into the chimney, then produce the flag.

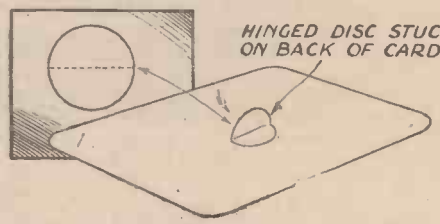



*Fig. 11.—The prepared card with a paper hinge fitted on the back.*

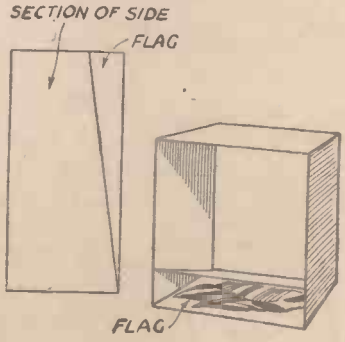



*Fig. 12.—Details of the faked chimney.*

# MAKE THIS SINGING ROBOT FOR THE PARTY

## Constructional Details for Making an Amusing Radio Robot That can be made to Talk and Sing in a Realistic Manner.

*Fig. 1.—The robot mounted on a chair with the portable set underneath.*

IT is possible for almost anyone to construct in relatively little time, and with inexpensive materials, a most amusing robot, whose active jaw and dancing eyes as he recites a poem or sings a song will entertain for hours!

First a suitable mask is required—one of those sold for the celebrations of Guy Fawkes Day will do very well. This may be mounted as shown in Fig. 2—the lower jaw having been first cut away. To the latter a T-shaped piece of paper may be glued, so that, when the jaw is fixed in position, the cross of the T stands behind the eyeholes and may have drawn upon it two black pupils.

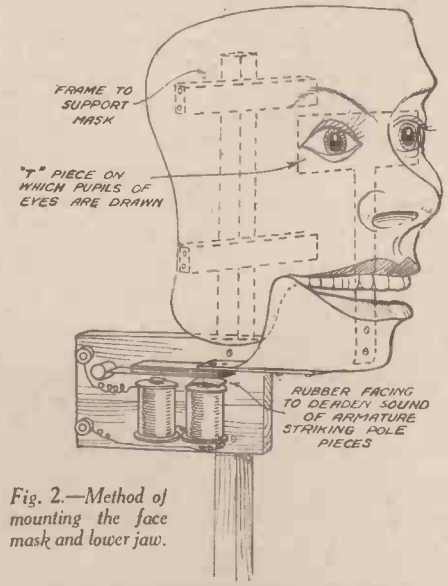



*Fig. 2.—Method of mounting the face mask and lower jaw.*

On the upright support are mounted the magnets and armature of a discarded electric bell. To the armature the lower jaw is now affixed, and we have the simple elements of our talking robot.

As the actual operating current will be relatively large, it is necessary to construct the following relay system—a system well worth assembly, as it may be used for wireless control of models, selenium cell operation, etc.

Referring to Fig. 5, the wires leading from the robot are connected to a relay R1, also made from a discarded bell, which closes the circuit of a two-cell cycle lamp battery (Fig. 6), thus operating the jaw and eyes of the figure. The contacts of this relay are the armature itself, and the pole pieces of the magnets, and, in order to prevent sticking, a small square of thin sheet-copper was soldered to the contact face of the armature.

Relay R1 is operated by R2 and a small 4.5 volt flashlight battery. R2 is the sensitive 5mA "Fulton"

*Fig. 4.—(Right) The completed robot ready for work.*

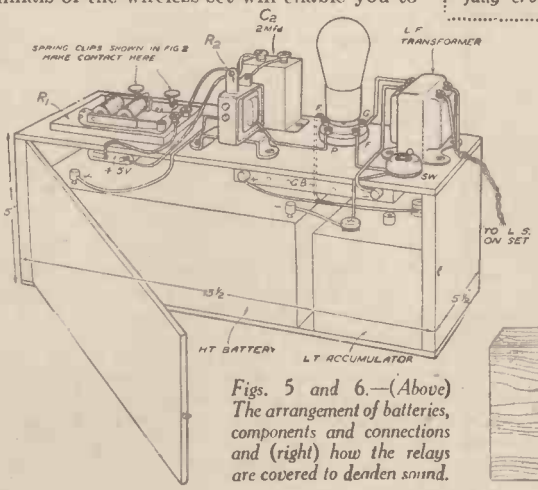
*Fig. 3.—The "works" of the robot.*

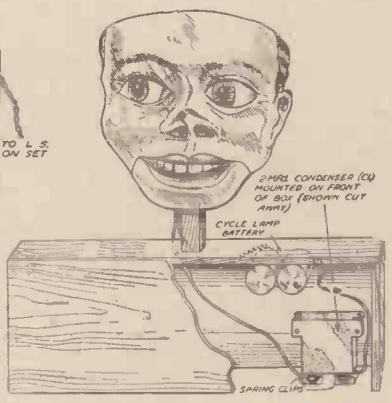
Relay sold by Electradix, Ltd., and it, in turn, is actuated by a valve. The latter may be any amplifying or power valve, and should have the requisite grid bias battery, as indicated in Fig. 5. The plate and H.T. + terminals go to the relay, and the grid and filament to the secondary of an ordinary intervalve L.F. transformer in the usual way.

A lead from the primary of the transformer is plugged in to the loudspeaker output terminals of a wireless receiving set (a portable receiver makes the whole assembly entirely independent of connecting wires to the mains, etc.) and it is now only necessary to tune in to a broadcast of speech or song when the talking robot will tell you all he hears! A microphone connected to the pick-up terminals of the wireless set will enable you to talk through the figure so that, with a friend, you might give a most entertaining dialogue!

The figure may be completed with an overcoat and hat (Fig. 4) or in almost any way the constructor fancies. My own model sits on a chair, the portable receiver being arranged underneath (Fig. 1) so that there shall be no interaction between the relay circuits and the aerial of the set. Condensers C1 and C2 have been included for this reason, but, of course, there is still a little interference, which can only be entirely eliminated through the use of separate wireless sets for the sound, and for the operation of the figure—the latter set having the loudspeaker switched off.






*Figs. 5 and 6.—(Above) The arrangement of batteries, components and connections and (right) how the relays are covered to deaden sound.*

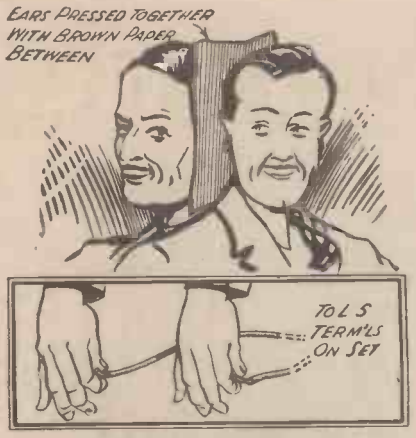



*Fig. 1.—Hearing the music without phones or loudspeaker.*

# Your Radio Set—

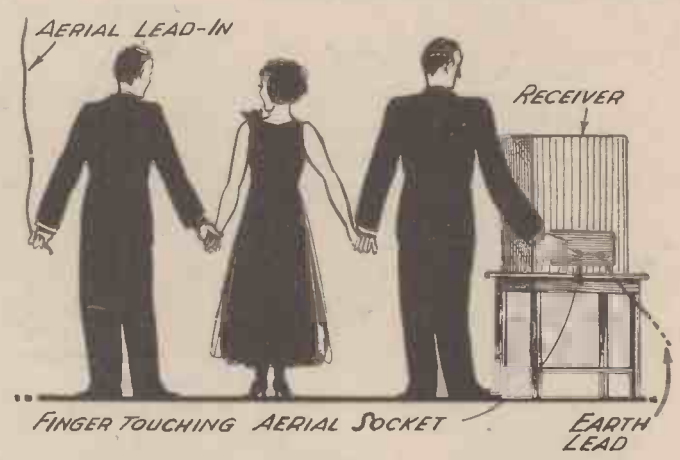
## *How The Standard Wireless Provide Entertainment Other Than*

AT this time of the year many parties are held, and it often becomes difficult to think of something new to do. Many of the old party games are played out, and anything new is not only greeted with enthusiasm, but will also give the host a name for introducing originality into his parties. The radio apparatus will no doubt be pressed into use to provide normal musical entertainment, either from the variety programmes, or by means of records reproduced through a gramophone pick-up, but there are many other interesting and amusing games which may be made up by employing either the radio receiver itself, the gramophone section, or the loudspeaker, and some hints are now given in this direction. It must be emphasised that the details given do not call for any interference with the normal working of the set, and will not entail any risk, either of damage or shock, even when an A.C. mains set is utilised. If the receiver is not fitted with pick-up terminals, these should be arranged for. Similarly, an output filter circuit should be used, and in a commercial receiver this may be done by connecting the extension speaker to the sockets marked for this purpose and silencing the built-in speaker—if a switch for the purpose is provided. (Fig. 4.) If it is not, then the existing speaker should be removed, and a good iron-core choke connected in its place. Terminals should be fitted and connected to earth and to the anode of the output valve through a 2 mfd. condenser as shown in Fig. 4.

### For Present Distribution

If a microphone is now connected to the pick-up terminals it will be possible to place a loudspeaker in one room and talk to your guests from another room. This alone provides endless scope for amusement at a party. For instance, there is certain to be a distribution of presents during the party—either to the children or the other guests. For the children, a Christmas tree will undoubtedly take a place in the decorations and the various gifts may be hung thereon, each wrapped and carrying a large number or some other indicating device which is easily observed. A list of these gifts, and the numbers or devices which they carry, should be prepared, and supplied to an "operator" in the room where the microphone is fitted, whilst a loudspeaker should be concealed beneath the tree, preferably placed close to the pot in which it is stood, and the whole covered with fancy paper in keeping with the remaining decorations. When the time for distribution arrives the children are marshalled and, after suitable announcements regarding the "magic" tree, a voice will emanate from it announcing that "Peggy" should step forward and detach the parcel bearing the number 1, or whatever gift is intended for her. In this way the pleasure of receiving the gifts will be greatly enhanced and the idea will be greeted with enthusiasm. But it need not be reserved for children only. If the older guests are to receive gifts, why not arrange for a similar type of distribution based on the "Spot Waltz." By playing records of a suitable waltz tune, the guests may take part in the dance, and the announcer should be placed in a position where he is able to see the Christmas tree.

*Fig. 2. — Disconnect the aerial lead from the set, and give the bared end of the wire to one person to hold. If a number of people now hold hands as shown with the end person touching the aerial terminal of the set, the music of the broadcast programme will again be heard.*




He should also control the music from the pick-up. When a couple are close to the tree, he stops the music, the guests halt in their stride, and the voice from the tree tells the nearest couple to take so many steps forward to the tree, stretch out the right hand, and take the parcel immediately on their right—or wherever it is. It will be seen that this idea alone is capable of endless variation.

### Musical Problems

Much amusement may be obtained from competitions in which the players have to guess various things. For instance, with a microphone in another room, various sound effects may be made by the operator and the players can be awarded points for the correctness of their solutions as to the source of the noises. If you doubt your ability to produce suitable sounds, you can obtain records of various noises from your local gramophone store (H.M.V. numbers DB. 4033-7, price 6s. each). If your gramophone motor is provided with a speed regulator having sufficiently wide control you can also try the effect of running records extremely slow or fast and see who can recognise the tune or artist. Only popular items should be used for this, as it is not a simple task. You can even run a record backwards (Fig. 5) or eccentrically to provide a similar competition (Fig. 6).

### Record in Reverse

The easiest way of running it backwards is to support a record on a pencil or spindle held in the hand, and rest the edge against the edge of the ordinary turntable. To produce the requisite friction, a length of insulation tape of the ordinary adhesive variety should be stuck round the edge of the turntable. If there is room on your motor board a spindle may be mounted firmly there. To run the record eccentrically, a hole should be drilled about ¼ in. from the standard hole, but if this is done, the needle must be placed on the first groove of the sound track before the turntable is started, as it will otherwise be impossible to place the needle down without damaging the record (Fig. 6). With care, you can burn the second hole through with an ordinary cigarette.

### Games

If lengths of wire are attached to the output terminals you can invent any number of games in which the junction of two wires completes the output circuit and thus joins up the loudspeaker (Fig. 3). For instance, the extension wires may all be bunched, and only one of the speaker leads

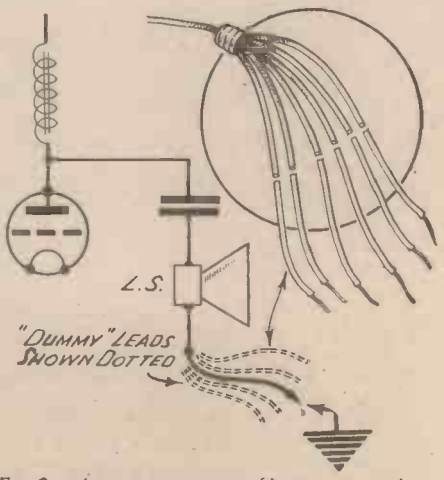



*Fig. 3.—Arranging an output filter circuit so that various games are possible.*

# As An Aid To The Party

## *Receiver May Be Adapted To Reproducing Radio Programmes*

included—the remainder being " dummies " not joined at the set end. Thus, one player may take an earth wire and the remaining players each take one of the remaining wires, and the object of the game is for the individual player to find the " live " return lead in the quickest time. By extending this you can introduce all kinds of games. The wires may be joined to metal studs (drawing-pins) on a board and they may be placed at such a distance apart that a standard coin (one penny, for instance) will link up adjacent studs. By making some " dead " and some " live " studs, points may be awarded, or prizes paid, when the return circuit is completed.

### Completing the Circuit

If a record is played, or a programme tuned in, the speaker will be silent, of course, until the points are linked, and thus it is immediately obvious when a player succeeds, and to add to the fun the sudden ejaculation from the speaker will, in many cases, cause more laughter than the fun of success. This is especially so if a talk is being received, as the disjointed words which are heard, appear very funny when disconnected from the remainder of the sentence.

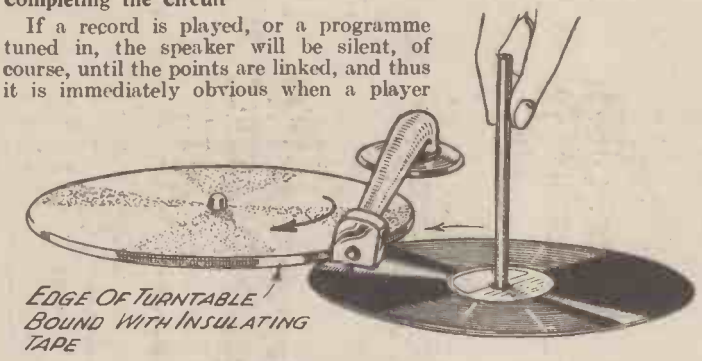



*Fig. 5.—The easiest way of running a record backwards is to support a record on a pencil or spindle held in the hand, and rest the edge against the edge of the turntable.*

For those who are not versed in the wonders of radio there are some interesting experiments which may be carried out to the mystification of the uninitiated. For instance, disconnect the aerial lead from the set, and give the lead to one person to hold (the bared end, of course). Now take his free hand in one of yours and with your other hand touch the aerial terminal or socket. The music or broadcast programme will again be heard, the two bodies acting as a complete aerial (Fig. 2). Similarly, a number of people may hold hands, and may even pick-up the local station without touching the aerial lead.

### Music Without 'Phones

It is also possible to hear the broadcast programmes without 'phones or loud-speaker—in the following way. Two wires are attached to the output terminals, and two people each take a wire in their hands. A sheet of dry brown paper is now held between the heads of these two people, and they press their heads together so that the paper comes between the right ear of one and the left ear of another (Fig. 1). It will be found that the programme is immediately audible due to the capacity effect of the two bodies and in some cases quite loud signals will be obtained. It is not safe to try this idea with a D.C. or Universal mains type of receiver unless good fixed condensers are already included in the output circuit. Even with a crystal receiver quite good signals may be obtained in this way.

To complete this subject it should not be forgotten that many of the old and popular types of game, and character playing, may be employed with improved results via the radio. As an instance, there are charades, and it needs little imagination to see that, with a judicious use of the microphone and players who understand the game, this may be made a most interesting subject. Whereas, in the ordinary playing of charades, one has to act and accomplish many effects in mime, through the microphone sound effects of all kinds may be introduced, in addition to the spoken word, and, thus, provide endless variety to the game. The radio may also be used as an embellishment in certain games—for instance, in the popular " Murder " game, the loudspeaker may be employed, with a microphone circuit, to broadcast a description of the victim and other incidental effects wherein the operator acts as a police chief.

Although some fun may be obtained by giving " Microphone tests " to the stage-struck, it is possible to make this an even more interesting pastime if a home-recording outfit is available. Your guests may then be permitted to make a record of themselves to take away as a souvenir, or during the festivities you can surreptitiously switch in a concealed microphone and make a record of the gaiety and incidental noises, which, played back later in the evening, may cause considerable amusement.

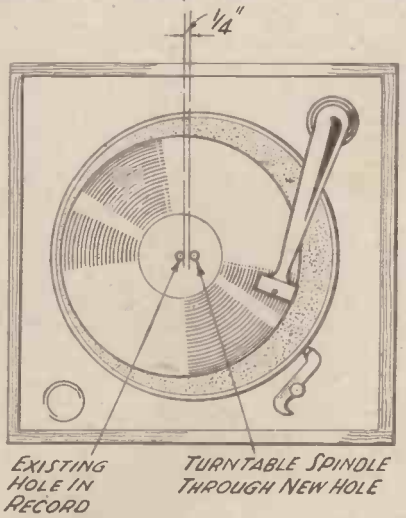



*Fig. 6.—A great deal of fun may be obtained by playing a record from an eccentric hole.*

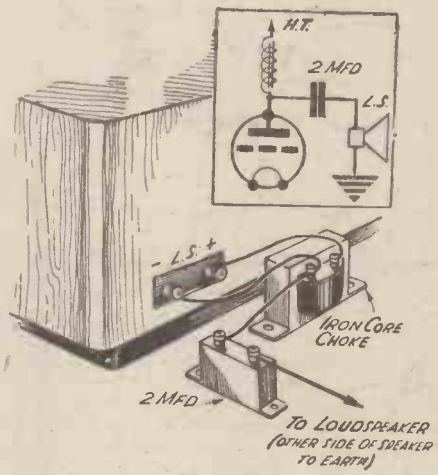



*Fig. 4.—Method of fitting an output filter if one is not already in existence.*

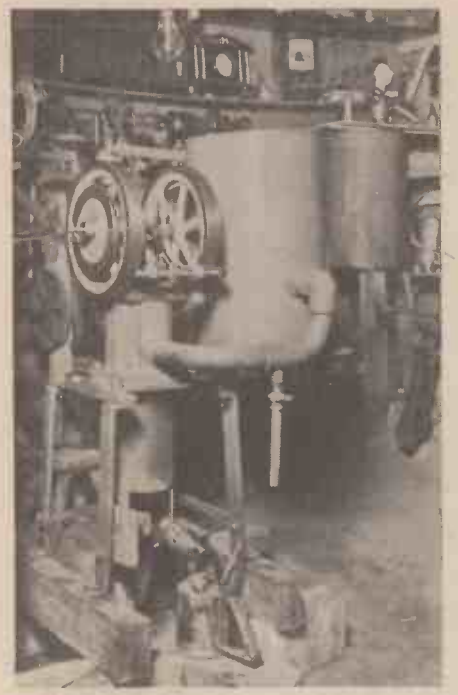
### For Radio Students

Finally, where a number of radio fans or students are gathered together—such as at a radio club or some similar place—it must not be forgotten that there are many interesting schemes which may be employed to provide a party spirit and, at the same time, to provide interest and knowledge. For instance, a number of spare parts could be supplied by each member, and the complete collection pooled. The secretary or M.C. could then sort these out into groups of parts depending upon the number taking part. These could be wrapped and numbered and the members would then be called into the room and each select a parcel. At the word of command they will untie the parcel and decide upon the best method of utilising all of the parts in their collection, the winner being the one who first makes a decision. The apparatus could, if desired, be built up. Similarly, an old set could be used, and various breakdowns and faults introduced, and prizes awarded for the member who succeeds in locating the fault in the shortest time—with or without instruments.

### "The Microscope"

WE have received the October issue of *The Microscope*, which costs 1s. monthly, and is published by Arthur Barron, Ltd., 20/21 Took's Court, Cursitor Street, London, E.C.4. This is an interesting journal which deals very thoroughly with all aspects of microscopy and contains helpful illustrations. Our readers interested in microscopy will find this little monthly magazine of great value, particularly in view of the dearth of literature concerning the microscope.

# THIS MONTH IN SCIENCE AND



*This remarkable machine is operated by the power generated by the expansion and contraction of metal*

## New Road Material

THE Department of Scientific and Industrial Research have for some months past been carrying out experiments with a view to combining rubber and tar into blocks for surfacing roads. Experiments have shown that chlorinated rubber —rubber treated with chlorine either in gas or liquid form—will mix suitably with the tar. The new material has not yet been tried out on motor roads, but chlorinated rubber-tar has been tested as a binding agent with various stones, from granite chippings to granite dust. Its binding power was found to be extremely efficient, and the rubber-tar can, under slight pressure, be made to produce well-bound blocks, particularly with granite dust. The present process of block making is rather expensive, however, so steps are being taken to discover a cheaper method of treating the rubber with chlorine.

## Jungle Railways

IN an effort to speed up transport the Brazilian Government intend to build railways through the virgin jungle as far inland as the huge undeveloped provinces of Goyaz and Matto Grosso. In addition to thousands of miles of railways, the programme is reported to provide for extensive highway construction intended to open up the hinterland as far north as Bahia.

## A New Motor Track

CAPT. EYSTON, who recently set up a new land speed record of 357½ m.p.h. on the Salt Lake bed in Utah, has suggested that a motor track 20 miles long and a quarter of a mile wide should be constructed in England. Capt. Eyston says:—"It seems altogether wrong that British drivers should have to take British cars to America to establish world records.

"Surely we could find a piece of land flat enough in England to build a 20 miles concrete track. I suggest it should be in the West Country, say in Gloucestershire. Apart from motor-racing it could be used as a runway for aeroplanes engaged in transatlantic air service." He thinks that with adjustments the "Thunderbolt" will be capable of still faster speeds. In his record-breaking run he said the most valuable asset was the gas respirator connected with the ventilation system of the car.

## Curing Black Eyes

MR. ABRAMSON, an assistant professor of physiology at New York College of Physicians and Surgeons, has invented a drug called histamine for curing black eyes in twenty-four to thirty-six hours. The drug acts as a synthetic beefsteak. Histamine is also being used in the treatment of arthritis, and for raising the skin temperature to relieve pain in neuritis. When used for treatment of black eyes the drug accelerates the absorption of the blood which discolours bruised skin.

## A Novel Machine

DR. A. S. CARR, a fifty-four-year-old engineer, has constructed a machine which is operated from the power generated by the expansion and contraction of metal. The machine which can be used to drive a lathe, develops two or three horse power, and is two feet high and eight inches square. As will be seen from the illustration a blow lamp is placed at one end of the machine for heating the metal which is then cooled by water at the other. The machine, which has taken Mr. Carr six years to perfect, is the result of over thirty years of experimenting, and he sees no reason why the same principle cannot be adopted to develop 100 h.p. The inventor says: "The engine is simplicity itself and it runs as smoothly and as quietly as a sewing machine.

"If I could afford it, I should certainly use an engine on this principle in a motor car. Used in aeroplanes, the engine would obviate the risk of fire or explosion of petrol tanks. It would, too, be very cheap to run, as fuel is not needed."

## High-Speed Targets

NEW high-speed target towing boats, designed by Mr. H. Scott-Paine, of the British Power Boat Co., Ltd., and built at his factory at Hythe, Southampton, are now going forward for delivery to the War Department, who recently placed a large contract for the craft. They are intended for towing targets in connection with coastal battery service. Hitherto, steam tugs of 300-400 tons and capable of a speed of only 10 knots, have been used for this purpose. These new boats have speeds of well over 30 knots and are extraordinary seaworthy and manœuvrable, so that the towing operation is greatly speeded up and conditions likely to be met with during war time are reproduced. The new boats are 57 ft. in length, with a beam of 14 ft., and a draught of 3 ft. They use two 500-h.p. Power Napier Sea Lion marine engines, and are fitted with wireless for shore communication and have sleeping and living accommodation for crews up to ten.

## New Fire Fighter

A SCAMMELL three-wheeled fire fighter was a feature at the Fire Week Exhibition recently held at Brighton. The vehicle is based on the famous Scammell Mechanical Horse chassis. Seats are provided for a crew of five firemen. Centrally is a tank containing 300 gallons of water, and on top of this are two first aid hose reels connected to the tank. Beneath the chassis is a power take off

*At work on a Hawker Hurricane, the fastest plane in the world. Its speed is nearly 450 m.p.h.*

# THE WORLD OF INVENTION

from the gear box of the engine for driving a first-aid pump. The chassis is extended to carry a stretcher type portable pump driven by a self-contained engine which can easily be lifted off by two men. The vehicle has been designed in co-operation with the Home Office.

## Electric Water Still

A NEW design of water still, which has just been added to the range of industrial electric appliances made by The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, will be of considerable interest to chemical manufacturers, the motor trade, breweries, and other industries where distilled water is required for a variety of purposes.

In this new still the water is boiled in the lower part of the vessel, and the steam condenses on an inverted-cone shaped lid. Special means are provided to prevent the distilled water from being contaminated, and a constant water level attachment is fitted so that the still cannot boil dry so long as cooling water is flowing. The heating elements are of the resistance type and are readily replaceable. The body of the still is constructed of heavy gauge copper, tinned inside.

## Remarkable Material

A NEW material of a semi-plastic nature, which has recently been produced is ideal for repairing leaks in boilers. The material can be inserted into the tiniest crack or hole when in a molten state and effects a permanent repair. The reason for this is that its melting point is well above the melting point of water which is 212 degrees F. The substance undergoes certain chemical changes when heated, thus upon becoming cold it forms a hard but elastic filling.

## Seaweed Suits

BY treating seaweed with a secret process which has recently been devised, it can be made into material suitable for garments, shoes and upholstery. Material so made is claimed to be rot-proof, fireproof and sound-proof, and from this it will be seen that it would make an ideal fabric for drapes and hangings.

It is cheaper than any other fabric used at present in these fields, and this seaweed-cloth is to be manufactured by an English firm. It should be noted that seaweed already has a number of uses, as it is used in the manufacture of soap and glass, as a fertiliser and for gelatin.

*Mr. B. Connett in his one-man home-made submarine in which he has made a number of successful under-water trips.*

## Talking Ribbon

ANOTHER gadget has been added to the list you can hitch to your telephone, this one to answer calls when you are out, giving any message you wish.

You merely push a switch before you leave the house, recite into a microphone the message you wish to be repeated, then push the switch again. Any calls which come in after that are answered automatically by the device, which repeats your message and hangs up.

When you return home you wipe your words off the tape with an electric eraser, leaving it clean for another message. The tape is made of steel ribbon, and in principle is somewhat the same as a gramophone record. This device is in use at Highstown, N. J., America, where it gives daily market quotations over the 'phone. (*New Ideas*).

*The unusual gondola of the stratosphere balloon under construction at Legjonowo, where final preparations for the ascent are being made.*

## A Stratosphere Attempt

PREPARATIONS are now being made at Legjonowo, near Warsaw, for a record stratosphere ascent which will be attempted with the Polish balloon "Gwiazda Polski." The illustration on this page shows the peculiarly striped gondola of the balloon.

## A Mechanical Fish

MR. B. CONNETT will shortly attempt a 37-mile underwater trip from Chicago to Michigan City, U.S.A., in his one-man homemade submarine which resembles a gigantic fish. The inventor has made several trips in his queer fish-shaped submarine, which is believed to be the smallest in the world. The boat is only 11 feet long, 23 ins. wide amidships and 37 ins. high. Mr. Connett has made 347 dives in it, has gone down to a depth of 31 ft. and has travelled as much as 14 miles underwater navigating with a 4 ft. periscope. The submarine is powered by two sets of batteries and has all the usual submarine equipment including blowers. oxygen supply, air-pump and respirator

*New Series*

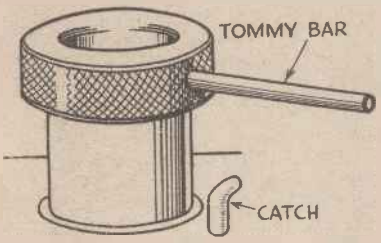
# TOOLMAKING AND TOOL DESIGN—2.

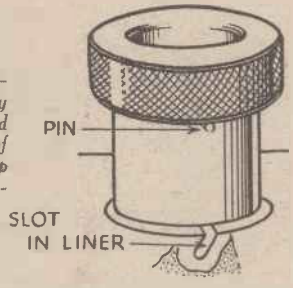
## The Principles and Methods of Making Press Tools, Jigs, Gauges and Fixtures

By W. H. DELLER

WHILE a knurled head will afford a grip sufficient to manipulate a small or medium-sized slip bush, larger ones are often operated by means of a tommy bar. This bar may be a loose one or fixed into the head of the bush. Where the latter arrangement prevails it can be made to provide the means of retention also as will be seen by reference to Fig. 3.

It may be in certain forms of jigs that the use of projecting catches as a means of securing slip bushes is precluded on account of the necessity of preserving unbroken flat surfaces with the bushes removed. In such instances it is usual to accomplish the locking of the bush by means of a pin inserted under the head and to incorporate the catch in the liner as in the manner illustrated in Fig. 4.




*Figs. 3 and 4.—(Left) How a tommy bar may be used to form a means of retention for slip bushes. (Right) Another method.*

Bearing in mind the necessity of having the guiding surface for the cutting tool situated as close to the work as possible, it may be that one or more holes are located at the bottom of a cavity. Where this occurs and the depth of the cavity is abnormal in relation to the length of a suitable standard drill, the bush is made to accommodate an extension shank as shown in Fig. 5. It should be pointed that even where a standard drill can be used, the mouth of the bush should be relieved by counterboring in all cases where the design dictates that its length needs to be above the normal.

Screwed bushes are sometimes used to serve the dual purpose of guiding the cutting tool and securing or assisting to secure, the work in the jig. This arrangement is not to be recommended, but where it is employed the thread must not be relied upon to locate the bush. A plain portion in the liner or insert for this purpose permits the thread being made an easy fit. Such a bush is shown in Fig. 6. Here the end of the bush is coned out when it may be used to locate and hold a cylindrical boss on the work to be drilled. Where a bush of this description is employed the opposing surface of the jib would be flat if the boss be on one side of the work. It may be, however, that the hole to be drilled is to pass through the end of a drop-forged lever having a boss on either side, in which case the screwed bush can be opposed by a fixed female coned bush to locate the under bossed portion. By the omission of the coned end it will be apparent that the bush can also be used for holding flat work.

### Methods of Holding Jigs

The manner in which a jig is held or secured to the machine table while the operation is being performed will largely depend upon the size of the job, or rather that of the drill or drills necessary to carry out the work and the type of machine available for the purpose. Thus, for a job that requires a series of small holes drilled by a sensitive drill, the jig can be provided with a handle for hand steadying.

With a similar machine and where the job is one that calls for one small hole only in each piece, the risk of drill breakage can be greatly minimised by securing the jig in the correct drilling position on the machine table by clamping. Reverting to the first example the jig can be permanently fixed to the machine table during use where an adjustable multi-spindle machine or multi-spindle drill head is available for the purpose.

Work of a heavier nature which has to be carried out on a multi-spindle machine to overcome the necessity of making 3 or 4 tool changes during the performance of a cycle of operations necessitates the moving of the jig from spindle to spindle on a common table. Here it is sometimes possible to arrange for the jig to slide between long parallel strips bolted to the machine table.

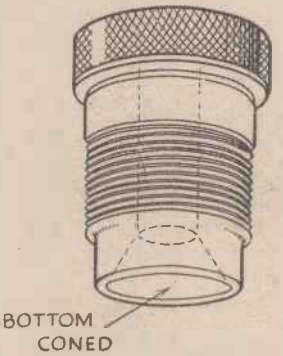



*Fig. 6.—The end of the bush coned out to enable it to be used to locate and hold a cylindrical boss on the work to be drilled.*

Jigs intended for use on pillar or radial drilling machines must be provided with bases to bolt on, or other provision made to clamp them down to the machine table.

Where the drilling has to be carried out in more than one plane it is often advisable to mount the jig proper by means of trunnions in a substantial frame which is bolted to the machine table. The various bushed surfaces of the jig are then brought into correct relation to the drill spindle by means of indexing mechanism.

Special purpose, or adjustable multi-spindle machines for drilling holes in different planes simultaneously would naturally require to have the drilling jig rigidly fixed in position.

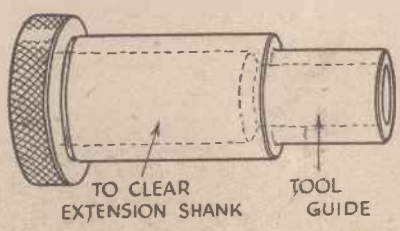



*Fig. 5.—A bush made to accommodate an extension shank.*

### Types of Drilling Jigs

Drilling jigs may be divided into three main types, namely, plate jigs, built-up jigs, and cast box jigs. Any jig is, of course, in reality a built-up jig, as seldom does it consist of only one piece, but the terms mentioned refer mainly to the form which the jig body assumes.

In countless instances a flat plate of metal suitably bushed and provided with some form of clamping device and suitable location points will provide the necessary jig. Other jobs demand that the jig be built up from steel or cast iron or a combination of both materials. While jigs may be built up from flat steel by a system of screwing and dowelling into a box-like formation, this practice is not one to be recommended for those of large proportions, and where the metal forming the body work has to be left in a soft condition, as constant use will most certainly render such jigs inaccurate.

The more satisfactory method is, for such jigs, to utilise a casting made from a pattern in which are incorporated the necessary bosses, projections and stiffening webs as may be necessary to provide rigidity.

### Methods of Construction

A plate jig can consist of a flat bright steel or machined cast iron plate into which hardened steel feet are screwed in the manner shown in Fig. 7. The height of these feet require to be such that they will raise the clamping arrangement used clear of the machine table.

Where this method of construction is used the means of location is usually secured by pins or suitably contoured plates screwed to the under side of the plate. A properly made casting for a similar jig can have stepped surfaces and abutments for locating points cast integral when there will be less likelihood of pieces working loose and causing variations in drilling.

One form of built-up jig which provides

(*Continued on page* 174)

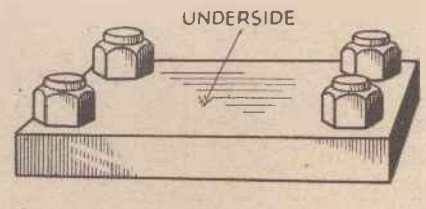
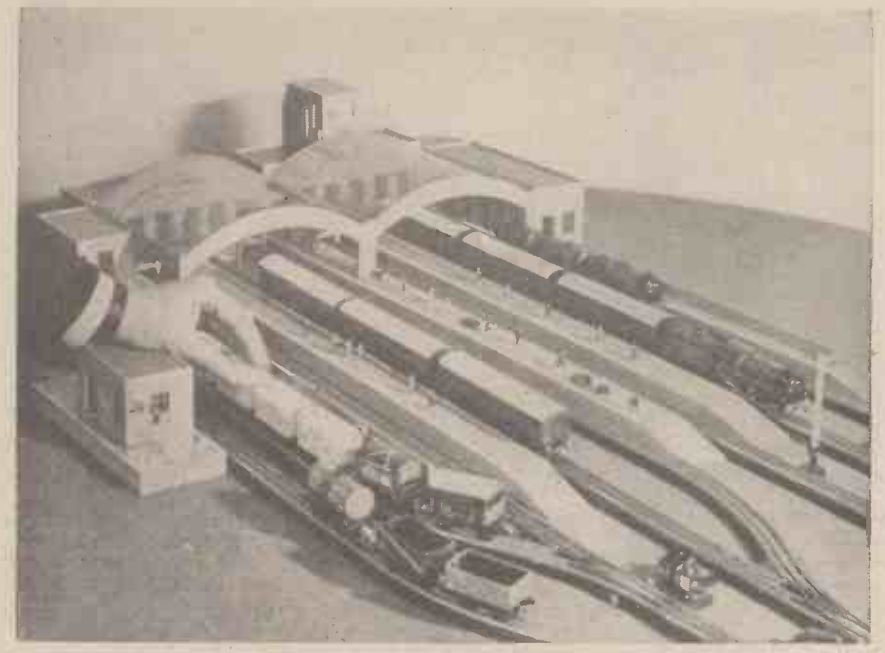



*Fig. 7.—Details of a plate jig.*

# WHAT'S NEW IN MODEL RAILWAYS

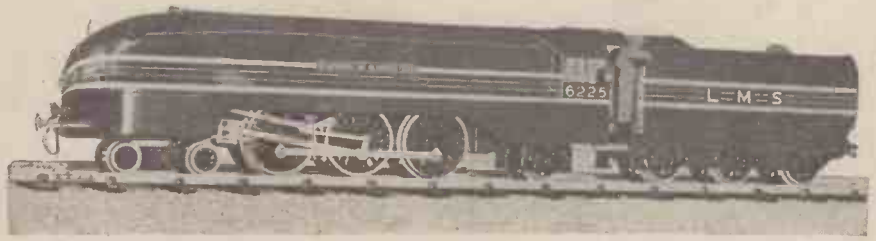
By W. J. Bassett-Lowke
M.I.Loco.E.

## A Description Of New Models And Accessories And Details Of The T.T.R. Automatic Uncoupling By Remote Control



*The Twin trains go south. A complete layout built up of "many ways" station parts, with all locomotives and rolling stock in Southern colours.*

AT this time of the year everyone is thinking about his winter hobby, and at Christmas-time there is always a "peak" of enthusiasm for model railways. I am still as keenly interested in this hobby as I was in my early days, and I think at least one reason for this is that it is a hobby that is continually progressing.




*The latest L.M.S. streamliner in gauge "O"—the red and gold "Duchess of Gloucester."*

*The L.M.S. "OO" gauge model train headed by the "Princess Elizabeth."*

And naturally to maintain popularity an older hobby must prove its worth against the newer interests of model flying, radio, television, etc., and to do this makers must be continually in the forefront with new ideas.

Now what is new in model railways this year? Let me take first of all the newest developments in the newest gauge, that is, "OO" gauge.

### Twin Train Railway

When the Twin Train Railway first came to England in 1935, I knew that it was a "good thing," but few people, I think, dreamed that in three short years it would have become so tremendously popular among all classes and ages of the British public.

This year in this small gauge there is the further innovation of the "Bassett-Lowke Scale Models" expressly designed and created for the T.T.R. Railway. The new models that are in production and will be ready by the time this article appears are—the 4-6-2 L.M.S. locomotive, "Princess Elizabeth," and the L.N.E.R. Pacific "Flying Scotsman."

You will see from the photographs the beautiful detail work on these comparatively inexpensive scale models. Each has an overall length of 10¾ ins. and is specially built to take the 14 ins. radius curves and points of the T.T.R. Railway with ease. Both models are fitted with a miniature reproduction of the Walschearts valvegear, As in all other T.T.R. locomotives, all the parts are made to gauge and are interchangeable, which makes the work of any repairs or replacements easy and very satisfactory.

*Upper quadrant signal in gauge "O" scale model.*

### Automatic Uncoupling

Perhaps the most important feature of these new models is the *automatic uncoupling by remote control.* With this new fitment it is possible to uncouple from a distance without altering any part of the track or line side control. The new device is contained in the locomotive tender and is fitted to both these express locomotives.

As those interested in the Twin Train Railway will know, it is operated by a series of sequence reverses, from the particular controller in the circuit. In the original, or should I say, ordinary T.T.R. locomotives, the "star" reversing device works in this sequence (pressing the knob in the centre of the controller).

1, Forward. 2, Stop. 3, Reverse. 4, Stop. For the new uncoupler device the sequences are:—

*The "Flying Scotsman" in gauge "OO."*

*Showing the application of photographic enlargements as scenery on the Twin Train Railway.*

1, Forward. 2, Uncoupling (continued forward direction). 3, Stop. 4, Reverse.

This uncoupling device is fixed, as I have already mentioned, in the body of the tender, and the magnetic mechanism, operated by No. 2 point in the sequence, depresses the coupling hook on the tender, and, by speeding up the black speed controller disc, the locomotive is drawn clear of the train.

### New Lines Introduced

The great feature of this new auto-uncoupler is that it does not affect the other operations of your T.T.R. scheme, and no alteration of the controller or rails or circuits is necessary. That is the idea on which the Twin Train Railway was created. All these new lines are introduced on the principle of continual development, not a scrapping of the earlier ideas. And again, hard wear is not sacrificed to design or price. The first thing considered by the designers is that the railway should work efficiently, and, where it is essential in the interests of good working to increase the size of certain parts slightly out of scale measurements, this has been done. Even so they have been successful in getting the railway exceedingly like the "real thing."

In addition to the locomotives, scale model bogie coaches and dining-cars, with electric lighting, are also available for these locomotives. They are 8¾ ins. long, have Celastoid windows, and are coloured and lettered accurately for both the East Coast and West Coast Expresses.

### Rolling Stock

For rolling stock the uncoupling problem has been solved in a different manner. Here it is desirable to effect the detachment of the individual vehicles while the trains are moving. With the new parts, attachable to any vehicle and fitted to any railway according to requirements, remote control uncoupling can be performed in a trailing direction at the command of the operator at his control switch board. The main principle of the wagon and carriage uncoupler is the use of an electrical remote-controlled ramp acting on a special lifting striker stirrup or trigger, fitted on the coupling and a new coupling link wire

Have you ever thought how you can improve the appearance of your layout by adding a background? A Twin Train owner in Switzerland, who uses the Continental types of locomotive sent me a rather unique photograph, showing how he has photographed the scenery in his district, had enlargements made, and fixed them behind his layout to give absolute realism. How well this idea could be applied to the beautiful English countryside!

### "O" Gauge

So much for gauge "OO." Now let me turn to gauge "O"—most popular and comprehensive of all gauges. Gauge "O" is equally suitable in clockwork, electric or steam, and, for the boy who is nimble with his fingers, offers great opportunity for building. There is the track, which can be laid inexpensively from scale model parts.

The model maker works to a scale plan, and with a track gauge, his permanent way will be true.

This year among locomotives, there will be all the fascinating streamliners—the red and gold "Duchess of Gloucester," which I think is more suitable for the L.M.S. than the garter blue "Coronation," as it matches the standard rolling stock of the L.M.S.; the L.N.E.R. blue "Empire of India" and "Dominion of Canada"; and the L.M.S. "Coronation Scot." These are super-detail models and are available in clockwork or electric a.c. or d.c.

I can also mention among L.M.S. Pacifics that the new "Duchess of Montrose" of the "Duchess of Buccleugh" class will be out this Christmas—an excellent sister locomotive to the "Princess Elizabeth." Scale expresses like these can be accommodated on the small curve of 6 feet diameter, but "S" bends should be avoided.

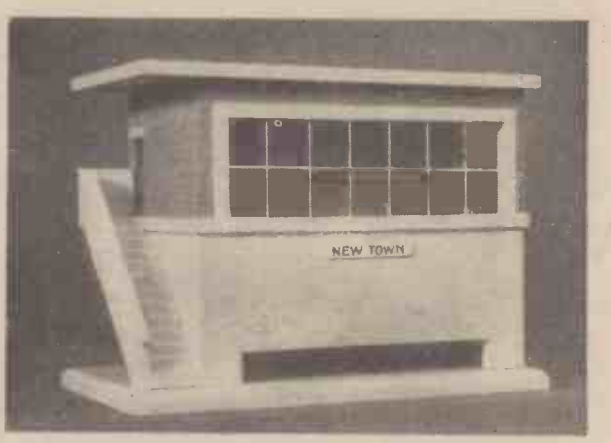
### Track

Those who are interested in track laying may be pleased to hear that the new centre rail chair used on the track of the Joint Railways Exhibit at the Glasgow Exhibition is now available for general model making use. The interesting point about these chairs is that they can be used with ordinary running rail, which, however, gives the track a more realistic appearance than the heavier orthodox centre rail.

Among track accessories, too, the colour light signal has come down in price this year, and it is possible to buy the new upper quadrant signal, at the same price as the ordinary tin-plate semaphore, which drops the arm.

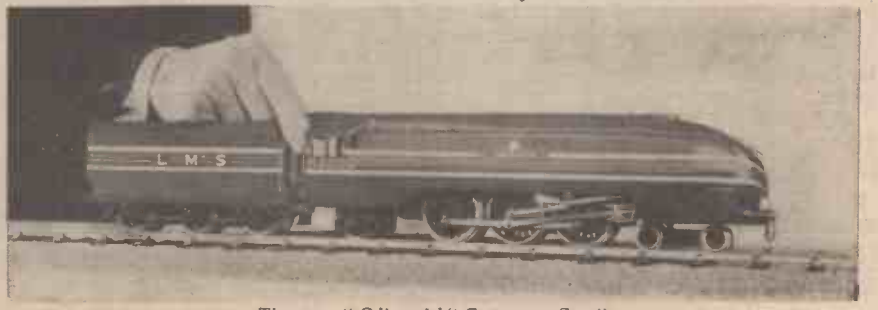
### New Signal Cabin

Last, but not least, I would like to mention the new signal cabin, "New Town," in modern style, which breaks away from the older idea of a pent or gable roof. "New Town" is a design that could easily be made up by a keen model railway owner, and would be in keeping with the developments on the Southern Railway for modern stations and railway buildings. The roof lifts off, thus making the levers of the signal frame easier of access.




*A new type of signal cabin, representing reinforced concrete and brickwork.*

To the boy who is thinking of taking up a hobby, I would say choose model railways, for in this way you can reproduce all the fascinating features of the full-sized railway in miniature, and it is not too much to say that a model railway is the finest combination of education and amusement that anyone could find.




*The gauge "O" model "Coronation Scot."*

*"PRACTICAL MECHANICS" WIRELESS SUPPLEMENT*

# THE LATEST TELEVISION DEVELOPMENTS

## Details of Some of the New Season's Receivers and Circuits Which are Adopted

*This is one of the big-screen televisors. An Ekco-Scophony product.*

WE have now had an opportunity of examining the various types of receiver which are on sale and it is interesting to note that considerable changes have been made in some of the receivers which were formerly on the market. At one time there was only one, for instance, which utilised magnetic deflection, all the remainder incorporating electro-static systems. The position has now been reversed, and the majority employ the magnetic system. The illustrations in this article show the interior of two well-known television receivers, one a Bush and the other an H.M.V. receiver, and the Bush illustration clearly shows the magnetic coils round the cathode-ray tube. These illustrations serve to show the general method of building the modern television receiver, where each section is built up separately on its own chassis, although in one or two cases the entire apparatus has been built on a single chassis. A good instance of this are the new Marconiphone and H.M.V. table receivers, where the makers have succeeded in crowding on to a single small chassis a 6-valve radio chassis and the 10-valve cathode-ray tube apparatus, whilst the small cabinet also houses the speaker and cathode-ray tube.

### Circuit Design

The radio side of most modern television sets is of the superhet type, the separate vision and sound signals being picked off by suitably adjusted circuits from a single frequency-changing stage, but in the Marconiphone and H.M.V. receivers the straight (T.R.F.) circuit is retained. The intermediate-frequency adopted in the superhet types of receivers varies and some value between 5 and 13 mc/s is generally adopted, the tuning generally being flattened to give a wide frequency response so as to retain picture detail. The bandwidth varies in the different models from 2 to 6 mc/s, whilst in some receivers single-sideband reception is adopted.

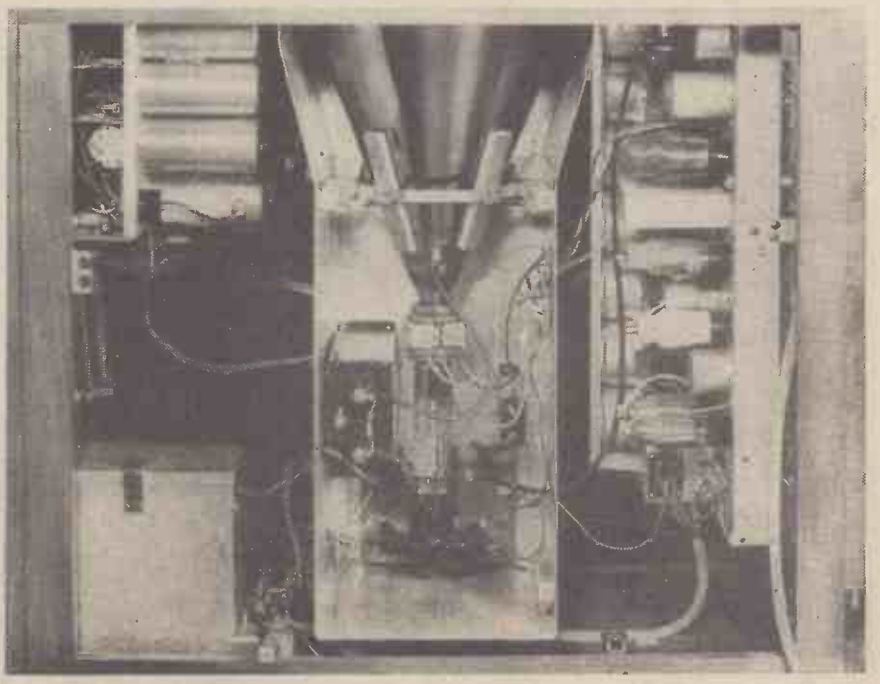
Apart from these main features there are several special details which are adopted by individual manufacturers. For instance, one maker at least has adopted an audible warning to show that the vision section is left on—it being understood that when the transmission has finished the screen will darken and it will not be possible to see that the set is left on unless some strong local interference is experienced, when flashes of light might be seen on the screen. In the receiver mentioned, which is a Tannoy set, a whistle starts up when the transmitter switches off and thus the user knows that the set should be switched off.

Another point of interest is that the standard resistance-capacity method of coupling, which has hitherto been thought to be the only satisfactory system for the time-base circuit, has been dispensed with in one or two sets, and standard transformer coupling employed with every satisfaction.

### Tube Sizes

There is still considerable controversy regarding the size of picture which should be adopted for normal domestic purposes. A 5-in. tube is employed on a number of sets, and the picture size varies according to the particular mask employed. In some makes the maximum area is utilised in spite of the curvature of the tube end, whilst in others the mask has been reduced so that a more or less flat picture is obtained. The size of the largest tube employed in the domestic receivers is 16-in., and again this is masked to provide slight variations in size by different makers. The practice of utilising a lens to magnify the size of the picture appears to have fallen out of favour, although several receivers are still available with the cathode-ray tube in a vertical position and the picture viewed by reflection

*A typical television unit providing only the television sound and picture*



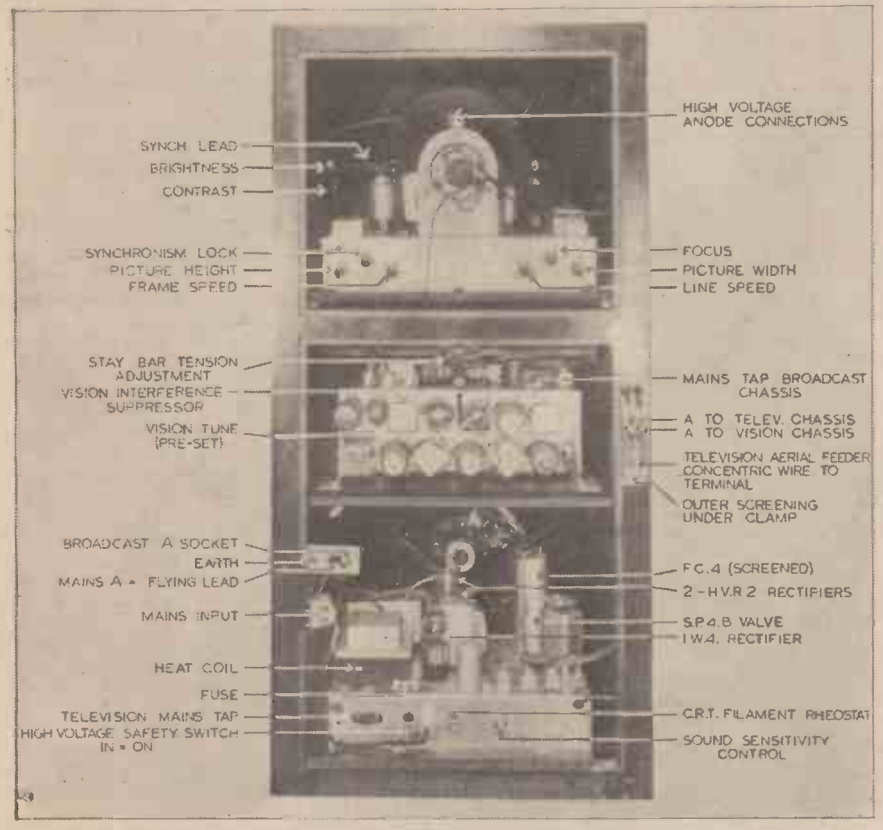
*An internal view of one of the H.M.V. receivers, showing how the various chassis and tube are arranged*

in a mirror. Glass protecting screens, either of plain or safety material, are also incorporated in some receivers, whilst others have the tube end directly exposed.

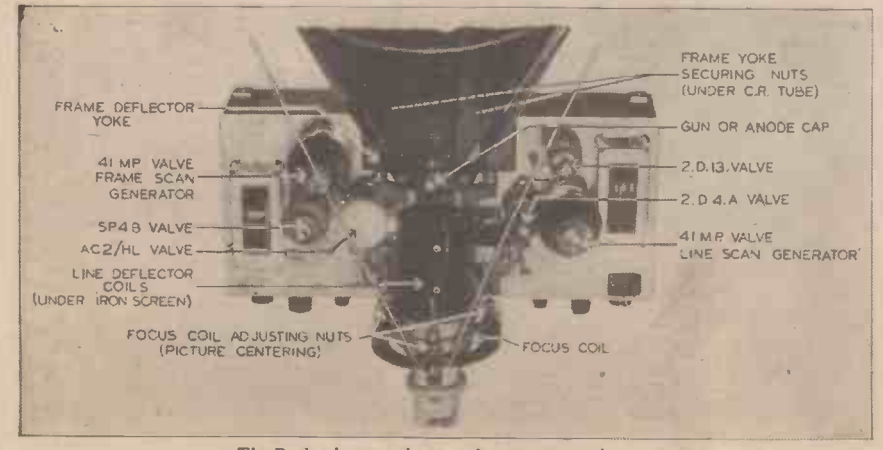
The very small type of tube, providing a picture about 2 ins. or so in length, is employed in the projection model receivers, such as are supplied by H.M.V., Philips, Baird, Pye and other firms. In these the tube is placed at the lower end of the cabinet, directed upwards, and a lens is used to project the picture on to a mirror from which it is thrown on to a screen. In the Baird receiver two screen sizes are adopted, and it is possible to change the screens in a very short space of time so that the desired size of picture may be obtained. The two screens measure 18-in. x 15-in. and 24-in. x 19-in., and fold inside the lid of the cabinet when not in use. The usual trouble with the projection type of receiver is that the picture must be viewed from a position as near as possible directly in front of the screen, and as the angle of vision increases the brilliancy of the picture rapidly falls off.

The general assembly of apparatus provide picture sizes as follow :

4 in. by 3⅜ in. (Invicta).
4¼ in. by 3¼ in. (Pye).
4¾ in. by 4 in. (Marconiphone and H.M.V.).
5 in. by 4 in. (Cossor).
5 in. by 6¼ in. (H.M.V.).
6¼ in. by 5 in. (Marconiphone).
7 in. by 5¾ in. (Kolster-Brandes).
7¼ in. by 5⅜ in. (Invicta, Pye).
7¼ in. by 5¼ in. (G.E.C.).
7½ in. by 6 in. (H.M.V., Marconiphone, Murphy).
7½ in. by 6¼ in. (Beethoven).
7¾ in. by 6¼ in. (Baird, Marconiphone, Ultra).
8¼ in. by 6½ in. (Cossor).
9 in. by 7 in. (Murphy).
9 in. by 7¼ in. (McMichael).
10 in. by 8 in. (Baird, Burndept, Cossor, Dynatron, Ekco, Ferranti, G.E.C., H.M.V., K.-B., Marconiphone, Pilot, R.G.D., Tannoy and Vidor).




*This diagram of one of the Bush receivers indicates the various separate parts.*



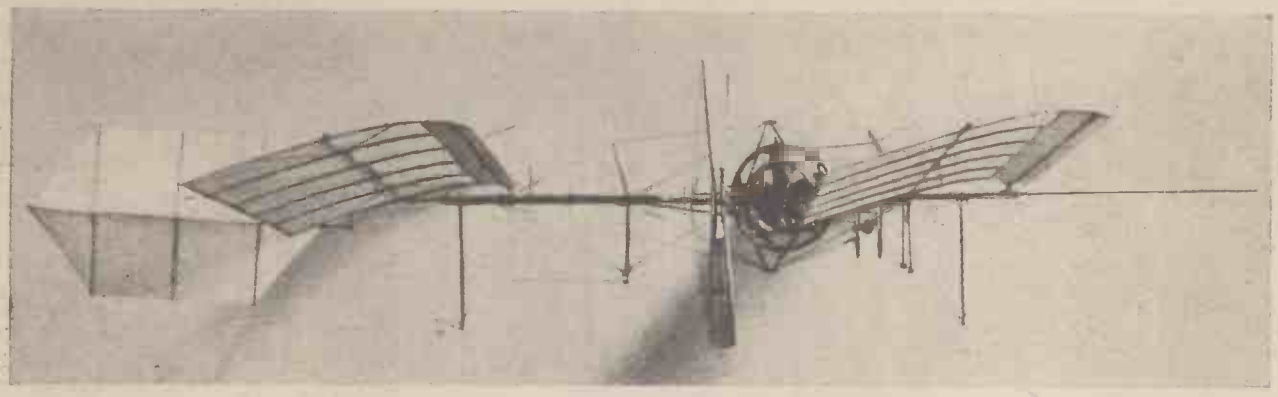

*The Bush television chassis indicating essential points.*

*A modern console television and radio receiver.*

10½ in. by 8½ in. (Ultra).
12 in. by 9½ in. (Cossor).
13½ in. by 11 in. (Baird, G.E.C.).
18 in by 14½ in. (Philips).
18 in. by 15 in. (Baird, Pye).
22 in. by 18 in. (H.M.V., Marconiphone).
24 in. by 20 in. (Ekco-Scophony)
6 ft. by 5 ft. (Scophony).

**Controls**

In some receivers a single control is adopted for contrast and a single one for volume on the sound programme, whilst in others it is possible to control from the panel the brilliancy, contrast, frame and other movements of the picture. It appears, however, that the general trend of design is to place all but the essential controls on a sub-panel out of sight and only retain one or two for normal use. The modern apparatus is so reliable that picture shift, sync, focus and other controls will hold for a considerable time without the necessity for re-adjustment.



*The first petrol model—Langley's Monoplane, now in The National Museum.*

# MODEL AERO TOPICS

## CURRENT NEWS FROM THE WORLD OF MODEL AVIATION

### S.M.A.E. Diary

I UNDERSTAND that the S.M.A.E. are proposing, next year, to produce a special Model Aeroplane Diary. This is an obvious necessity now that the model aircraft movement has grown to such large proportions and is continuing to grow to even larger proportions. I hope the diary will be made very complete, by including, not only the usual technical data, but practical information of use to the lone hand. It should contain a complete list of affiliated clubs, and non-affiliated clubs should not be included unless they have been established for more than three years, have held regular meetings, and have a membership of over 15 members. So many clubs spring up like a mushroom over night, send out notices to the press, become included in press lists of clubs, only to fade out within a month. Anyone consulting such a list is annoyed when he finds upon writing to the secretary of the club that it had ceased to exist for months, even years. Another point is that such clubs should be listed in alphabetical order under the name of the town from which they operate, For example, if the name of the club happens to be the Midland Aero Club it is unlikely that anyone will consult the word Midland, but will look up the name of the district in which he resides to ascertain whether a club exists there. I suggest that the S.M.A.E. should thoroughly investigate the whole question of club titles and refuse to affiliate such clubs which do not conform to some formula to be laid down. I suggest that some purely local clubs should not be permitted to adopt some all embracing title such as "The Midland Counties Model Aero Club," the "Sussex Model Aero Club," or the "Scottish Model Aero Club."

When a whole county is taken in the title any other club formed in that county may seem to be outside the pale. I hope the diary will also contain a complete list of the year's fixtures, and I have no doubt that the date fixing conference of the S.M.A.E. could be arranged so that the matter could be included. Much of the material which at present appears in the S.M.A.E. Handbook could be included in the diary.

### Next Year's Wakefield Contest

A DINNER is to be held at Lizbeth Hall, Soho Square, on December 14th, to launch the Wakefield Fund for 1939. Dr. Thurston will be in the chair. At a recent Council meeting the necessity for sending a team to America to compete in the Lord Wakefield International Trophy Competition was discussed and the Dinner is a result of that discussion. In connection with the Wakefield Competition the Council has decided that in launching 1939 Wakefield models only the propeller and wing tips should be held. Suggestions that the Wakefield contest should be a team contest was defeated, but the Council passed a vote that a supplementary prize should be given to the team.

### Bobbins and Shafts

THE bobbins to which I referred last month and which are marketed by Premier Model Aero Supplies, prevents the rubber from being cut on the hook or creeping over the hooks or shaft, bunching in the fuselage, and rattling and upsetting the stability of the model. The Baby size for 1/32nd, 1/16th or ⅛th elastic motors, and fitted with 20 S.W.G. shafts cost 1d. each; the Minor for ⅛th and 3/16th elastic, fitted with 18 gauge shaft 1½d. each; the Major for 3/16th and ¼in. elastic with 18 or 16 gauge shaft 1½d. each; and the Standard for thicker ¼in. strip elastic 2d. each. The method of applying these bobbins to single skein motors is shown overleaf. It is advisable when ordering to specify how many strands of elastic you propose to use, and what width and gauge. These bobbins are very light in weight, the Baby weighing only 1/54th of an ounce, and the Standard only 1/22nd of an ounce.

### Our 1 c.c. Engine

MR. G. W. GRAVELL of 34 Penn Street, Islington, N.1, has sent me a photograph (see next page) of the 1 c.c. engine which he has made from the drawings, description and photographs recently given in this journal. This is only his second attempt at model making, and the engine does him great credit.

Sets of Blueprints are still available from us for 5s., post free.

### The Cloud Airmaster

THE photograph shows the Cloud Airmaster which has a wing span of 7 ft., length 4 ft. 8 in., a wing loading of 10½ oz. per square foot, and complete weight 4½ lbs. The price of the kit, less engine, is 52s. 6d. Any 1/5th h.p. engine may be fitted, and the kit contains two sheets of drawings, an ample supply of timber, cement, dope, covering material, inflatable wheels, ready cut ribs, all metal fittings, and instructions. It is supplied by Cloud (Model) Aircraft, 304 High Street, Dorking, Surrey.

### An Impulse Starter

I HAVE tested one of the Impulse Petrol Engine Starters supplied by the same

*The Cloud Airmaster petrol model.*

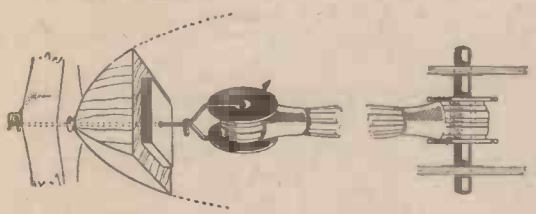
Company and find it most efficient. It is especially useful for starting engines of 1 c.c. I have also tested one of their Austin Flight Timers which is very satisfactory and certain in action.

### Skybirds

I REPRODUCE a photograph herewith of one of the realistic Skybird models—a Fairey Battle. This photograph was entered in their recent Photographic Competition. Skybird solid non-flying scale model construction kits are correct in design and detail and the parts leave just sufficient work for the modeller to add the interesting touches and refinements which encourage him to make a perfect model. Skybirds offer a wide range of such kits. The same Company are running a Gift Card Scheme. Each card is supplied with an order gift and prize coupon which can be exchanged for Skybird models. These cards cost 5/- and are obtainable from Skybirds agents. The latest Skybird accessories include anti-aircraft defence models, the latest service type lorry, searchlight, sound locator, Lewis gun, and models of human figures. A list of Skybirds models is obtainable from Messrs. A. J. Holladay & Co., 3 Aldermanbury Avenue, London, E.C.2

### The First Gas Model

EVERYONE who has been associated with model aircraft for a few years knows that Langley built the first power model aeroplane in the world to make long flights



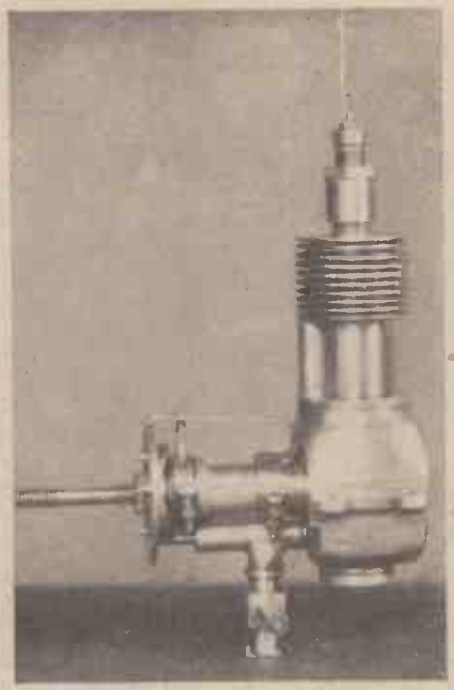
*Premier Model Co.'s rubber bobbins*

under its own power, but very few know that he also built and flew the first petrol-driven model. Langley's Steam Powered model, it will be remembered, was catapulted from the top of a house boat on the Potomac River on May 6th, 1896, and it flew for 90 secs. and covered half a mile in that time. This performance it consistently repeated and even improved upon. At that time the distance record stood at 368 ft., and it was flown by one of Lawrence Hargreave's compressed air models in 1890. Hargreave also held the duration record of 23 secs. Hargreave used flapping wings to propel his models, and at that time the best that had been achieved by screw propulsion was 120 secs. by Penaud in 1870.

Langley's Aerodrome No. 5 weighed nearly 30 lbs. and it was, therefore, heavier than any living flying creature and much heavier than any model that had ever before flown, and only John Springfellow, in 1848, had succeeded in making a steam power model fly for a very short distance. May 6th is still celebrated in America as Langley Day. The flight was witnessed by Alexander Graham Bell who sent a report to the scientific journals of the day.

Langley's petrol model was a one-fourth size replica of a full size machine he intended to build, and the engine was built by Charles M. Manly in the Smithsonian Workshops. Manly first tried to make this engine an air-cooled one, a type which did not come into use until 1909. The engine was eventually constructed with stationary cylinders, and gave 1½ to 2 h.p., although after 30 secs. run it overheated. In June, 1901, the petrol model was taken down to Widewater on the Potomac and on June 18th, the first test flight was made. It was catapulted and the model started off and flew for about 100 ft. and then landed on the water. It was only in the air for 4 or 5 secs. On the second flight it flew for 300 ft. in 10 secs.

In Oct., 1901, a rebuilt engine was installed in the model, although I cannot trace records of what it did.



*Mr. Gravell's 1 c.c. petrol engine built from our designs. This is only his second effort at modelmaking*

### Our Wakefield Design

IN order to give everyone of my readers a chance to compete in the Wakefield eliminating trials, from which the team to represent this country in the Wakefield contest next year (it is to be held in America), I intend to publish in this journal the design for a model which will comply with the rules.

The competition is open to everybody, and to save readers the trouble of interpreting the rules, before I publish the photographs and details in this journal I shall submit the model to the Competition Committee of the S.M.A.E. so that they can approve it.

I shall issue a set of full-size blueprints, and it is also my intention at present to run a contest for readers who build the model, irrespective of whether they enter it for the Wakefield contest. In the meantime I shall be glad to hear from interested readers (a postcard will do), so that I can gauge how many people are interested.

A competition of the international importance of the Lord Wakefield International Contest attracts a good deal of attention in this country, but it is my opinion that an even larger number of competitors should enter for the eliminating trials.

I hope that schoolmasters and scout masters will this year take an interest in it. It may be that the eliminating trials will have to occupy two or three days, but the more entrants we get the greater is our chance of bringing the cup back to England next year.

I also hope that the competition will be run in such a way that it does not give rise to the criticisms which we have had this year.

### Unafiliated Clubs

I ADVISE all unaffiliated model clubs to affiliate to the S.M.A.E. and enjoy the benefits which the society confers. The society is run on well-organised but democratic lines, and in the past three years has done an enormous amount of good for model aircraft, as is evident from Lord Wakefield's continued support. Many famous names are associated with it. The fees are low and in the interests of all modellers, it is desirable that the hands of the S.M.A.E. should be strengthened.



*The Skybirds model "Fairey Battle"—true to type*

# AN ELECTRICAL GAME OF CHANCE

## An Electrified Version of the Old Game of Put-and-Take

By "Handyman"

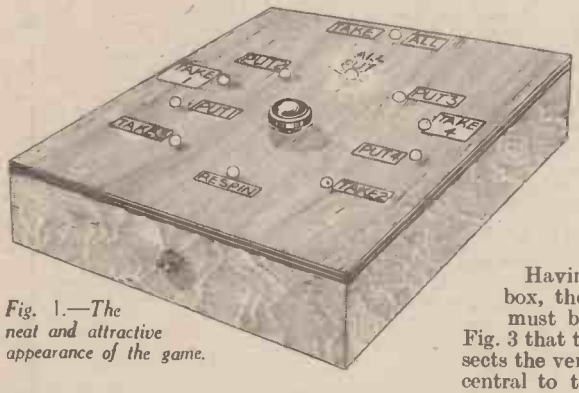



*Fig. 1.—The neat and attractive appearance of the game.*


*Fig. 2.—Another version of the game.*

MANY readers will recall the days of the "Put-and-take" top, the excitement and enjoyment which this simple game brought to parties. The electrical version of this game, about to be described, is equally if not more thrilling, having the added attraction always to be found in games of chance where gaily coloured lights are used.

The original put-and-take top was hexagonal, thus permitting only six different "Results" and it will be seen that by using the principle embodied in this new method, any number of puts and takes can be arranged according to the requirements of the constructor; coloured lights determining the results of the spinning.

This lighting is accomplished by using a system of progressive contacting to the bulbs, the source of current being derived from a small torch battery. This lighting sequence is arranged so that instead of having a uniform run of lights, a fascinating effect is obtained by staggering the lighting so that the bulbs flash hither and thither.

To make the game still more thrilling, five more values have been included, and these are P3, T3, P4, T4 and "R."

Reference to Fig. 1 will show the neat and simple appearance of the game, and the method of designation.

### The Fly-wheel

When the knob is twirled, the momentum of the movement is governed by a fly-wheel, so designed that an unvarying sequence of spins results, since, in a game of this nature, any excessive friction of either the "wiper" on the circle of contacts, or the faulty alignment of the bearing and fly-wheel, will result in the fly-wheel coming to rest in almost the same place at the end of each spin, therefore this point requires the most careful consideration of the whole assembly.

The model is of robust construction, and as will be noticed ½-in. oak runners have been used for the box, with thick oak ply for the board. However, this is again an entirely optional feature, the measurements given being a guide for other designs.

Having made or obtained a suitable box, the circle of holes for the bulbs must be drilled, and it will be seen in Fig. 3 that the centre horizontal line intersects the vertical centre line at a point not central to the underside measurements of the board. This is intentional, since more room is allowed for isolating the "Take all" bulb, and a pleasant design is obtained.

Having obtained this point of intersection, the next step is to draw a 2-in. circle, thus preparing a "setting" line for the inside edge of the twenty contacts. A protractor should be used for marking off twenty angle lines 18 degrees apart, three of these being shown for clarity, and to save time it is best to plot half the circle only, carrying the lines straight through the centre thus completing the other half. These angle lines will facilitate the setting for the contact pieces, measurements of these being detailed in Fig. 3.

Referring then to Fig. 5, it will be seen that an old condenser provides both the wiper contacts and the bulb contacts.

Each wiper contact is first of all obtained by marking out the correct size for each on a few of the dismantled vanes of the condenser, placing one vane at a time in a close-jawed vice, and prising over the vane along the marked lines, finally beating flat with a hammer.

Each piece of aluminium must now be carefully filed with a fine file, and the edges e.1 and e.2 within the approximate limits shown, should be filed smooth, thus obviating the possibility of a sharp edge impeding the wiper wire "W"—(a piece of ordinary radio flex)—see Fig. 4.

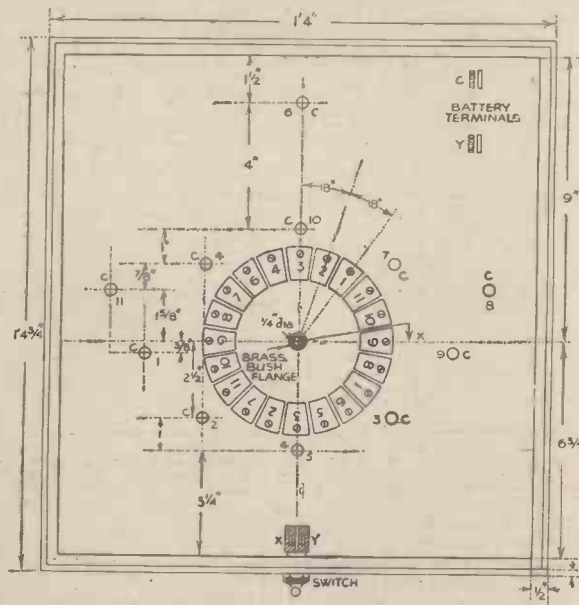



*Fig. 3.—An underneath view of the game. Measurements are shown for one side only for clarity in this diagram, the other side being exactly the same.*

### Drilling Holes

It is always advisable to drill the holes through the top or face of the board, thus preventing the tendency to splinter the surface through the end of the drill bit forcing instead of cutting its way through, whilst such a fault would not be so bad if occurring on the underside of the board. This is a small point, but must be stressed, since when it comes to the question of designing an attractive face on the surface, a good finish cannot be obtained with a marred background.

It will be seen that thirteen holes have to be drilled, eleven $\frac{5}{16}$ in. diameter for the bulbs, one for the bearing and another for the toggle switch or any other type of switch preferred. These having been drilled, the question of mounting the contacts can next be considered.

The positioning of the twenty contacts should not offer any appreciable difficulties providing a further circle is drawn, intersecting the 18-degree angle lines and determining the positions for the segment fixing screws, and gimlet holes, prior to fixing, will facilitate this operation.

### Fixing the Contacts

Small countersunk wood screws approximately ¼ in. in length will do for fixing all the contact pieces including the bulb contacts, and whilst dealing with the fixing of these contacts, there is a very important point to note. As the contacts are of aluminium the connecting wires will, of course, only be soldered to the brass wood screw heads, and eventually any sawdust

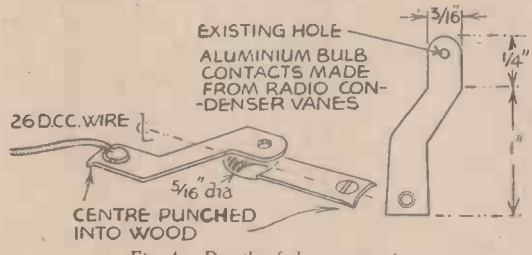



*Fig. 4.—Details of the contact pieces.*

or other dirt liable to be left in the box after construction, will possibly work it's way in between the contact and the screw head, thus making a faulty contact. Having experienced this fault, I should like to stress the importance of employing brass contacts where possible.

The wiring diagram, also included in the underside plan Fig. 3, will be explained by employing the numeral system thus avoiding any confusion which might result in indicating all the wires. It will be seen that the contact pieces have references such as 6-c for "Take all," 4 and 5, for "Respin," and numerals from 1 to 11 for the wipers of contacts. It will be noticed that the corresponding numbers to various contacts are located at diametrically opposite points, the numbers in question being as follows: 2–2, 3–3, 6–6, 8–8, 9–9, 10–10, 11–11, whilst the odd sequence is thus: 1–7, 4–5, 7–1. The reason for this is that all the lights flash individually at two positions of the fly-wheel during one revolution, this, of course, excepting the "Put three" and "Respin" which are arranged so that the "Put three" comes up once by itself and the second time in conjunction with the "Respin."

### The Contacts

The contacts throughout can be wired in accordance with this system by connecting together all similar numerals for the bulbs and wiper contacts, for example, the "Take all" position has the designation 6-c so a

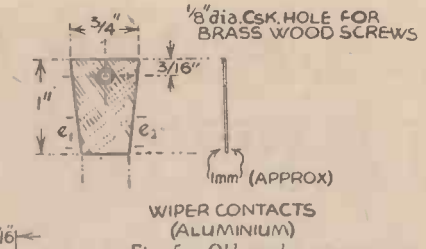



*Fig. 5.—Old condenser vanes are used for the wiper and bulb contacts.*

length of suitable wire, say 26 S.W.G. double-cotton covered, should be soldered to one side of the bulb (6), the other end being taken to both correspondingly numbered wiper contacts 6–6; the reference (c) on the "Take all" bulb holder is then commoned to all the (c) designations on the board, all connections, of course, being soldered.

### Wiring

The wiring should be kept sufficiently

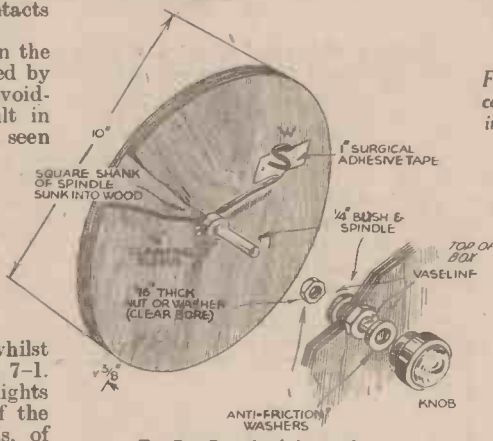



*Fig. 7.—Details of the revolving arm.*

long to allow fashioning the resultant cable round the circle of contacts, and the switch connections must be followed in the same manner, Y-Y on battery, and X-X wiper wire. The connection to the wiper bearing should be made by arranging a short groove between the two contacts 10 and 9, and sinking the wire at this point into the woodwork, having previously soldered the same to the bearing bush flange on the side.

The fly-wheel is the simplest part of the whole assembly, but as stated in the opening paragraphs, care must be taken to ensure ease of momentum, and the washers illustrated in Fig. 7 must be included to reduce "back-lash" and friction.

A battery clip can be fitted to the side of the box as shown, and depending on the type of battery used, the use of a strip of mild steel or iron may be found serviceable and strong enough to prevent the battery slipping out.

A thin ply-wood back with fixing screws,

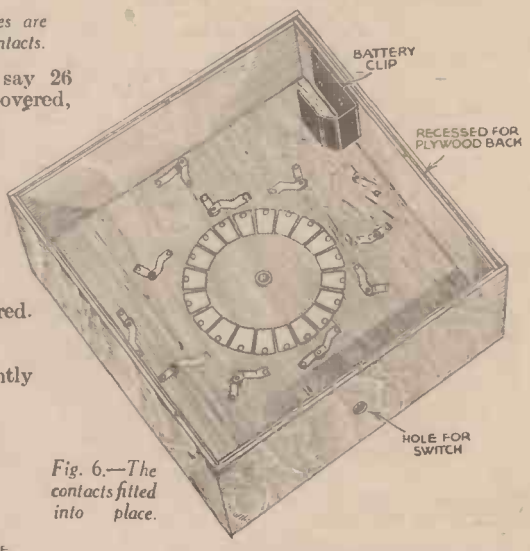



*Fig. 6.—The contacts fitted into place.*

not nails, is advisable to keep out the dust, etc., but I have not found this absolutely essential.

### The Bulbs

The bulbs should be screwed into the 5/16-in. holes now provided, and the contacts underneath should be watched to ensure continuity.

These bulbs may be of either 2·5 or 3·5 volt type, working from the 3 or 4·5 volt battery respectively, and an interesting point here is that if the constructor is a radio man, and may have a mains step-down transformer handy, giving 4 volts output, this may very simply be employed in place of the battery, and it is a method I can very well recommend.

The only particular deviation in the sequence of lighting is the effect of the two lights "Put 3" and "Respin" coming up together at one point in the revolution of the fly-wheel, and is quoted again as a reminder when testing out the model, the "Put 3" appearing once only by itself. Another version of this game is shown in Fig. 2.

# SAFEGUARDING LONDON'S WATER SUPPLY

*How Beef Plays an Important Part in Preventing Polution of Water*

TWENTY pounds of best silverside beef will be delivered twice a week to the new laboratories of the Metropolitan Water Board in Clerkenwell, London, E.C. The meat is to make broth, not to sustain the chemists, bacteriologists and biologists of the staff, but to fatten colonies of germs, notably Bacterium coli. Care is taken by the "cooks" to make the beef broth as nutritious as possible. It is mixed with agar, a seaweed extract which forms a jelly, and with sugar, and on which, if Bacterium coli does not flourish, it is not the "cooks'" fault.

The scientists have to keep a close watch on him because he is an indication of the amount of pollution in the water. They let him batten and breed in incubators kept at 42 degrees C. for 24 or 48 hours, then they test his reactions to all sorts of substances and finally have him completely tamed. The laboratories safeguard the 8,000,000 Londoners who rely on the Board for their supply of water.

Every day about 120 samples are taken from reservoirs of filtered and unfiltered water, in sterilised glass-stopped bottles, by a dozen men. The filled bottles, all labelled, are delivered to the laboratories and the 43 men employed there begin their work. The bacteriologists, having prepared the "media," which is their name for the forms of broth jelly, inoculate test-tubes or glass dishes containing the germ food with samples of water to test them for bacteria.

The biologists are concerned with the minute plant and animal life which is taken out of the river water by filtration. There is a prime authority on taste in the laboratories. He tastes 20 or 30 samples of water a day—about 7,000 a year—taking a sip from a glass, rolling it over his palate and spitting it out. He prepares a daily report of his tasting and it usually reads, "No taste in all samples," but, on occasion, he may find something which he describes as "earthy," "mouldy," "musty" or "chemical," and then the other experts are called in to find the reason before the customers start complaining. The Metropolitan Water Board have absolute confidence in the palate of their water-taster.

# Strange Mechanical Ideas

## Weird Contraptions Which Were Invented Many Years Ago

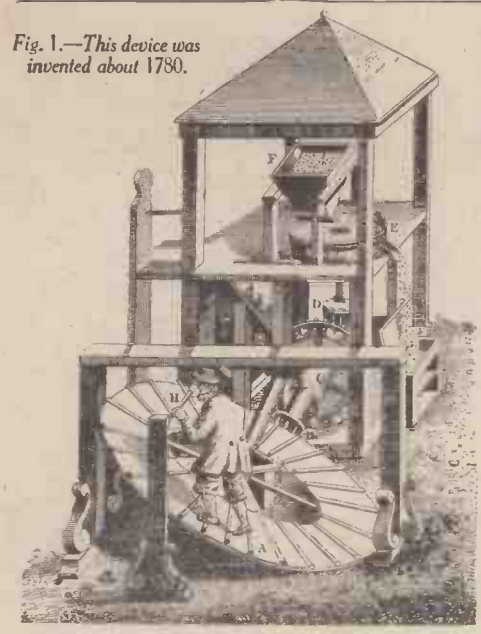


*Fig. 1.—This device was invented about 1780.*

THE mechanical (?) creations of Mr. Heath Robinson, the humorous artist, will be well known to most readers, but some of the contraptions put forward in *all seriousness* by their originators are hard to beat. Take Fig. 1 for instance: the date of this contraption is about 1780, and it appears in more than one important book of the time. One would say that "absence of mind" is indicated. Fig. 2 shows a device intended to provide light for coal-miners at their work. Light was produced by holding a flint against the revolving wheel; but whether it was actually tried out, and with what results we do not know.

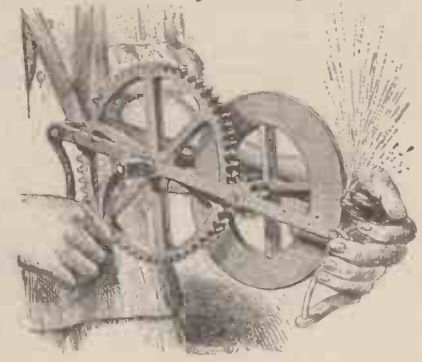


*Fig. 2.—A light for coal miners.*

### Remarkable Scissors

The pair of scissors shown in Fig. 3, embodying a simple device for sewing, must have cost the inventor a good deal of thought, but it could hardly have brought him much return.

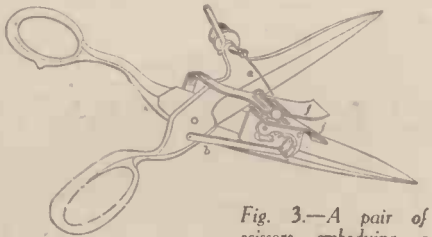


*Fig. 3.—A pair of scissors embodying a device for sewing.*

For those with a super-abundance of energy to work off, the attractive exerciser shown in Fig. 5 must have appealed very strongly. It seems a pity that it was not arranged to do some useful work, such as running the domestic wringing machine.

*Fig. 4.—A swimming machine.*

*Fig. 5.—A "keep fit" device.*

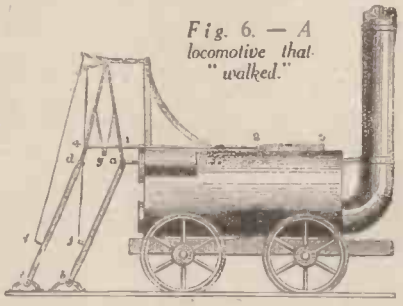


*Fig. 6.—A locomotive that "walked."*

For those of mechanical bent, and at the same time fond of the water, the swimming machine shown in Fig. 4 should have been the very thing. It is not stated whether the swimmer keeps the machine afloat or *vice versa*. The locomotive shown in Fig. 6 which was arranged to push itself along by means of legs, for sheer stupidity would be hard to beat.

### A Twin-hull Steamer

The twin-hull cross-channel steamer illustrated in Fig. 7 was actually constructed by the Thames Ironworks and Shipbuilding Co., and launched in 1874. We do not know what ultimately became of her.

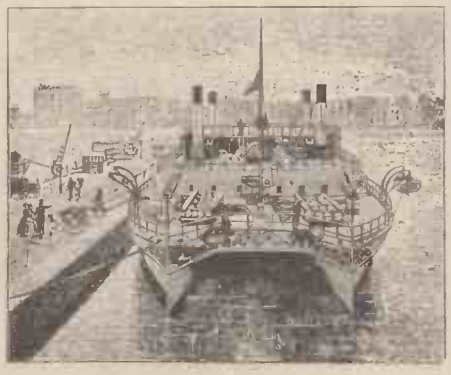


*Fig. 7.—A twin-hull steamer.*

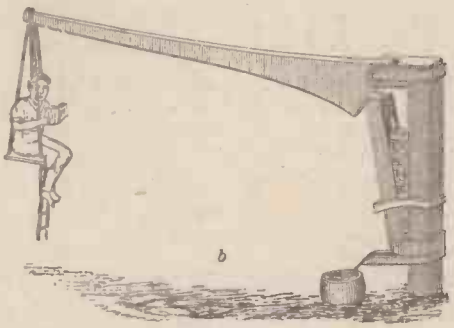


*Fig. 8.—The Herbert oil press.*

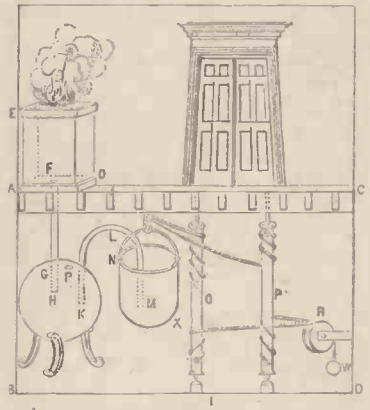


*Fig. 9.—Hero's idea for opening doors.*

*Fig. 10.—A device for the "book worm."*

The idea of Hero of Alexandria (over two thousand years ago) shown in Fig. 9 for opening the great temple doors by an

*Fig. 11.—Bell's reaping machine.*

unseen and apparently magic power appears to have had much to recommend it; and it seems quite possible (unlike some other things) to have worked. They were pretty good showmen in those days, and we have no doubt that the effect of this piece of temple equipment impressed the humble "yokels" and correspondingly helped to fill the temple coffers.

**For the Bookworm**

Even the needs of the most assiduous bookworm were not overlooked by the inventor, as will be seen from Fig. 10. This dated about 1760, and is really in advance of its time, as it is actually more suitable to the present day of hurry and pressure. Imagine yourself, for instance, bent on a big reading output, being seated at one side, with an assistant on the other, clearing and reloading the shelves.

In contrast to the exercising machine shown in Fig. 4, we show in Fig. 8 what was known as the Herbert oil press for crushing olives and other oil-producing fruits and seeds. Note the "worker" in the seat with his book.

**Putting the Cart . . .**

The old saying of "putting the cart before the horse" is well illustrated in Fig. 11, which shows Bell's reaping machine of 1826. Finally Fig. 12 shows a suggestion of some centuries ago for a fire engine in

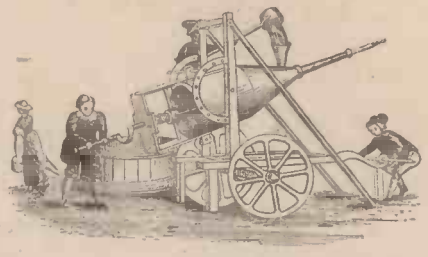


*Fig. 12.—A fire engine in the form of a huge syringe.*

the form of a huge syringe. The above article and illustrations are reproduced by courtesy of the Hoyt Metal Co. of Great Britain, Ltd.

# A NOVELTY GAME FOR CHRISTMAS

**"Spin-a-coin," as the Game is Called, is Ideal for the Party.**

THIS game affords considerable amusement in that it requires careful strategy on the part of the contestants. The rules are at the discretion of the players.

The main object is based on the usual principle of attaining the highest score, the points in this case being registered by the indicator and electric bell or buzzer (see small theoretical circuit inset).

A wire (*a*) is attached to thin tin strip and wire (*b*) is attached to the framework of the coin indicator panel. The bell or buzzer should be fitted inside the "box" at a suitable position (this addition is an indication of the various methods which may be adopted by the constructor in making the game more interesting).

The measurements A and B should be in the neighbourhood of: A—8 ins.; B—18 ins. to 20 ins.

To obtain a suitable "pitch of coin"—that is the distance from the runway to the coin reception cloth at the rear of the board—the cloth is fitted in a manner which serves two purposes: (*a*) to receive coin; (*b*) as a dust cover for the indicators when game is over.

The aluminium or tin coin panel should measure approximately 6 ins. long by 3 ins. deep with the flanges about 1 in. in width, this measurement is adaptable to the size of game being employed.

The slots should measure as follows:—

| | *Length* | | *Width* |
|---|---|---|---|
| 1d. | 1¼ in. | ... | 3/16 in. |
| ½d. | 1/16 in. | ... | 3/16 in. |

**Details of the Slots**

The diagram illustrates three 1d. slots and four ½d. slots with the indicators arranged as follows, reading from left to right, ½d. score 5, 1d. no indicators (must ring bell to score 20 otherwise nothing to record with that penny). ½d. score 10, 1d. no score, must ring bell to gain a further 20 points, ½d. score 10. 1d. must ring bell to score 20. ½d. score 5. These rules are adjustable to requirements, but indicate one method of playing. The number of indicators used is, of course, left to the designer.

| Slots | Points without bell | Bell Rung | Bell Not Rung but coin resting in slot |
|---|---|---|---|
| ½d. | 5 | — | 2½ Points |
| 1d. | None | Add 20 | 10 ,, |
| ½d. | 10 | — | 5 ,, |
| 1d. | None | Add 20 | 10 ,, |
| ½d. | 10 | — | 5 ,, |
| 1d. | None | Add 20 | 10 ,, |
| ½d. | 5 | — | 2½ ,, |

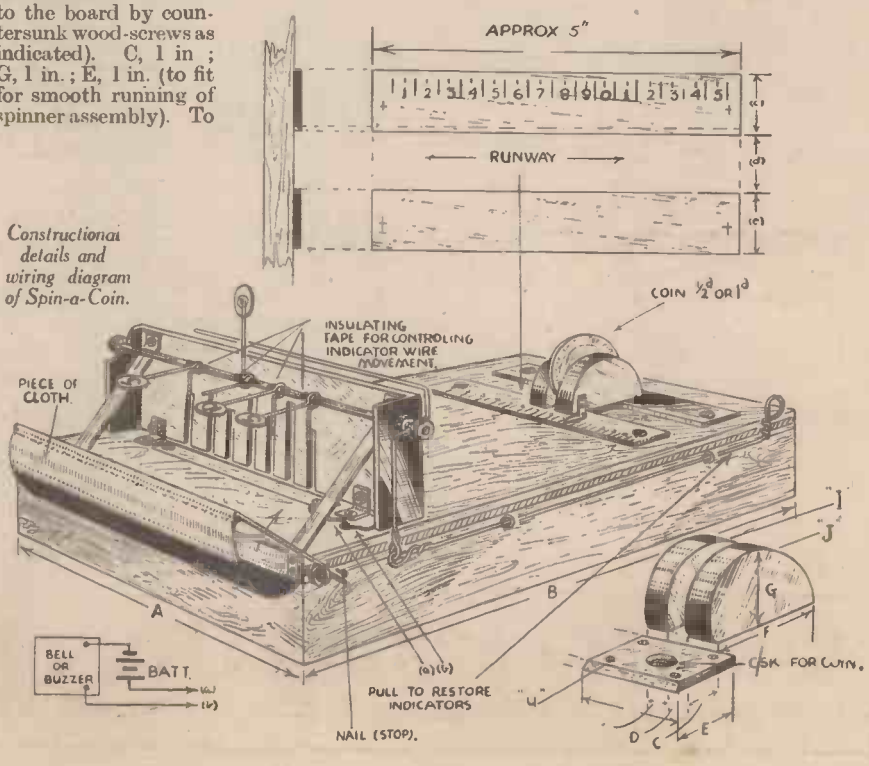
The coin panel is secured by brass angle brackets which in turn are fixed with counter-sunk wood screws to the base-board. (See that the contact strip of tin does not foul the framework or brackets in any way, otherwise the bell or buzzer will keep ringing due to this short circuit.)

The method of fixing an indicator release wire is apparent on referring to the drawing and is a simple additional construction, but is not absolutely necessary.

The following measurements should be adopted for the coin spinners: C, ⅜ in.; D, 3/32 in.; E, 1 in.; F, 1¼ in.; G, ⅛ in.

*Runway.* Length to suit. (These pieces of aluminium are screwed to the board by countersunk wood-screws as indicated). C, 1 in.; G, 1 in.; E, 1 in. (to fit for smooth running of spinner assembly). To attain a smooth bevel on the "runway" strips, place these in a vice and use a fine file. This bevel should fit snugly with the aluminium under-piece which is drilled in the four corners to take 6B.A. csk. screws which clamp this strip to the brass coin holders I and J which in turn are drilled and tapped underneath in the appropriate position indicated by the four holes in the above strip.

To attain a spin and force behind the coin, countersink with a fairly large "bit" the exact centre of the aluminium strip referred to above; the edge of the coin will then fit into same lightly, and when the player places his first finger on the coin and presses the coin at the same time drawing his finger away from same, this will propel the coin and shoot same (which attains a spin) along the board. A little practice will prove the rule and very little difficulty will be realised either in the construction of this novel game or in the spinning and gauging of the coins used.




*Constructional details and wiring diagram of Spin-a-Coin.*

# PREPARING PIGMENTS FOR PAINTS

## A Practical Article Which Will Appeal to Model-Makers Since it Gives Clear and Straightforward Directions for the Making of High-Quality Paints and Enamels for Model Colouring and Similar Uses

*The dried pigment is placed into a mortar for grinding.*

THE preparation of paints and varnishes on a large scale is decidedly not a home occupation, for not only is it "messy" in the extreme, but it also necessitates the employment of grinding, mixing, and grading machinery.

The making of small quantities of high-quality paints of the oil or the water variety is, however, an entirely different proposition. Given a home work-room—or even a spare table—a few mixing and grinding vessels, and, of course, an interest in chemistry, it is possible for any worker to produce for himself quite a range of very fast paint pigments which may, subsequently, be made up as oil, cellulose, or water-colours, and shaded, accordingly, to the requirements of the individual.

The use of a home-made paint or enamel adds an extra interest to model-making, and to constructional work of all kinds, for when home-built articles are finally assembled and finished off with one or two coats of home-made paint or enamel, the essential individuality of the product is utterly complete.

**Showcard Designing, etc.**

Home workers who occupy themselves with showcard designing, ticket-writing, poster production, modelling, and many other crafts will, at times, find a supply of home-made paints, of special colours and shades, extremely useful in obtaining effects which are not easily to be attained with the usual run of commercial colours. Indeed, there is hardly a craft worker—or an individual who takes a pleasure in making articles with his hands—to whom the small-scale manufacture of paints and colours will not, in some way, appeal.

Paints consist of a highly-coloured, insoluble material (the "pigment") mixed, or "suspended," in some appropriate medium. In the case of water-colours, the pigment is usually mixed with water containing gum arabic; the water, afterwards, being evaporated until the paint reaches a pasty consistency, in which condition it is put into tubes or jars. If, on the other hand, the water is almost completely evaporated, the paint attains a solid, or "cake," condition—familiar to all in the well-known "paint-boxes" of students and artists.

Oil paints and enamels, on the other hand, are those in which the pigment is suspended in an oily medium containing a greater, or less, proportion of dissolved resin and a trace of a chemical substance known as a "drier," which accelerates the drying rate of the paint. If the resin proportion of the paint is high, the product is usually termed an enamel.

**Table of Colour Mixtures**

| *To obtain* | *Mix* |
|---|---|
| Purple, violet, heliotrope | Red and blue |
| Green ... ... | Blue and yellow |
| Orange ... ... | Red and yellow |
| Pink ... ... | Red and white |
| Grey ... ... | Red and blue, or black and white |
| Dark grey ... ... | Green and red |
| Brown ... ... | Red, yellow and blue |

A large number of pigments can be produced by the chemical operation of "precipitation," that is to say by simply adding one chemical solution to another, stirring, and then filtering off the coloured "precipitate" which is thus formed. If, for instance, we add a solution of potassium chromate to a solution of lead nitrate, or lead acetate, we immediately obtain a bright lemon-yellow precipitate of lead chromate, which is known in the paint trade as "chrome yellow." If, again, we add a solution of ammonium, or sodium sulphide, to a solution of a cadmium salt, we obtain a precipitate of a full golden yellow colour, consisting of cadmium sulphide—the well-known and very beautiful "cadmium yellow."

*Precipitating the pigment by adding one chemical solution to another.*

It will be seen, therefore, that it is not a matter of difficulty to add one chemical solution to another and to filter off the coloured precipitate thus formed, this precipitated pigment being, subsequently, made up into paint of one variety or another.

On page 142 we give, in tabular fashion, instructions for the making of an extensive range of paint pigments. Each pigment is produced merely by adding one chemical solution to another. The chemical solutions should be approximately equal in strength, and should be mixed in about equal quantities.

*The production of lamp black by holding a large vessel over turpentine-saturated sand which is afterwards ignited.*

*Rubbing the ground pigment through muslin in order to obtain it in the finest possible powdered form.*

Actually, the exact strength of the solutions is immaterial, but it is best to keep them fairly concentrated in order that a large bulk of pigment may be precipitated in a small amount of liquid, and thus obviate the necessity of filtering a large volume of liquid. It is preferable for the solutions to be warm, since this usually makes for speedier filtering.

The mixed solutions containing the precipitated pigment are filtered through blotting paper and, afterwards, a quantity of warm water is poured through the pigment, as it lies in the blotting paper, in order to wash away any traces of the chemical solutions which may be clinging to it. Finally, the blotting paper, containing the pigment, is opened up on a plate and placed in a warm oven to dry.

When dry, the pigment is thoroughly ground up. For paint intended for "rough" or "priming" work, the pigment may be mixed-up in this rough-ground condition, but for the finest qualities of paint, it is absolutely essential to rub the ground pigment through muslin, or similar cloth, stretched over a frame. In this manner, the pigment is obtained in the form of an impalpable powder and will give rise to paints of the highest quality.

In order to make water colours from the above pigment, the latter is simply ground up into a paste with the minimum quantity of water containing a little dissolved gum arabic. The resulting paste may then be stored in small screw-capped jars or other convenient containers. If the water colour is required to dry with a considerable amount of gloss, the gum-arabic proportion of the water may be increased and, also, a small amount of ordinary sugar may be dissolved in the water. In all paints containing gum arabic, it is necessary to add a drop or two of carbolic acid, oil of cloves, or some other preservative, in order to prevent the gum from turning mouldy.

Oil paints are most conveniently made by stirring the pigment into a quantity of the finest varnish. An "enamel paint" will thus be formed, and it will dry with a high gloss. If this gloss is unwanted, it may be eliminated by diluting the varnish with turpentine before incorporating the pigment with it.

Cellulose paints may be produced by mixing the pigment with a fairly thin solution of scrap celluloid in amyl, or butyl acetate. This will give a medium-slow drying cellulose paint of high gloss and good resistance.

*Separating the precipitated pigment from the liquid by means of filtration.*

In addition to the chemically precipitated pigments embodied in the Table, there are, of course, others which can be made with almost equal ease. Of these, some of the more important are enumerated below:

*Lampblack. Carbon Black.*—This is made by burning camphor, or sand saturated with turpentine, and by holding a large glass or earthenware vessel over the flames. The black smoke condenses on the sides of the jar in the form of a light powder which is jet-black in colour. This is lampblack, the most permanent and fadeless of pigments. It is best to incorporate a little blue with it in order to increase the "deadness" of the black.

*Charlton White.*—Known, also, as "Lithopone." It is made by mixing zinc sulphide and barium sulphate in equal proportions, the mixed pigments being ground up into paint.

*Brunswick Green.*—This is a mixture of Chrome yellow and Prussian blue.

*Vermilion.*—A sulphide of mercury, made by adding sodium sulphide to a solution of a mercury salt and by heating the mixture for some hours.

*Chinese red.*—Made by boiling lead chromate ("Chrome yellow") with ammonia.

*Iron red Rouge.*—Made by heating ferrous sulphate.

"*Silver.*"—This consists of aluminium powder. It is not suitable for water colour work.

"*Gold.*"—Ordinary gold paint has a pigment consisting of tin sulphide, a golden-hued material which may be made by heating a mixture of tin-mercury amalgam, sulphur and sal ammoniac. The mixture is heated slowly, the fumes being allowed to escape into the open air. Tin sulphide or "mosaic gold" remains as a mass of golden scales.

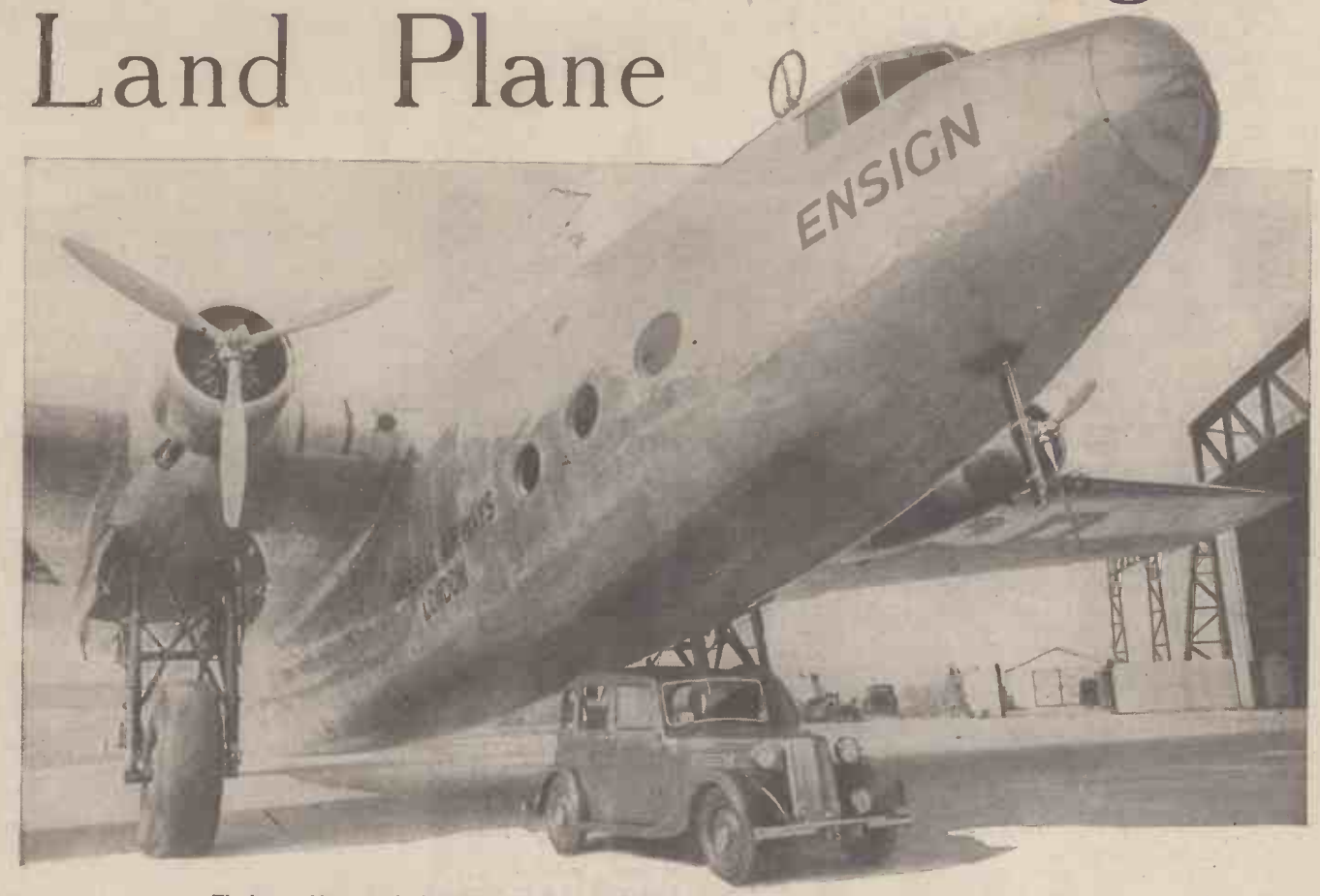
"Shading" of paints, that is to say, the bringing of the paint material up to exact shades by means of colour mixing, is best performed after the pigments have been made up into paint; although, of course, it may be carried out with the dry pigments in their powder form. From the various pigments, whose preparation is described in this article, almost any colour and shade may be obtained by careful admixture. For "paling" the shades of paints, that is to say, for rendering the colour of a paint or pigment less intense, use is often made of the various white pigments, such as: Chinese white; Charlton white; and Barium white.

## PAINT PIGMENTS

| COLOUR. | NAME. | CHEMICAL COMPOSITION. | MADE BY MIXING SOLUTIONS OF: |
|---|---|---|---|
| Blue ... | Prussian Blue ... | Ferric ferrocyanide ... ... | Perchloride of iron (ferric chloride) and potassium ferrocyanide. |
| ,, ... | Turnhull's Blue | Ferrous ferricyanide... ... | Sulphate of iron and potassium ferricyanide. |
| ,, ... | Cobalt Blue ... | Cobalt and aluminium hydroxide. | Cobalt chloride, aluminium sulphate and caustic soda. |
| Green ... | Chrome Green | Chromium oxide ... ... | Potassium bichromate and ammonium chloride (with subsequent boiling). |
| ,, ... | Nickel Green (Pale). ... | Nickel Oxide ... ... ... | Nickel sulphate and caustic soda. |
| Yellow... | Chrome Yellow | Lead chromate ... ... | Lead nitrate or acetate and potassium chromate. |
| ,, ... | Barium Yellow | Barium chromate ... ... | Barium chloride and potassium chromate |
| ,, ... | Cadmium Yellow | Cadmium sulphide ... ... | Cadmium chloride and sodium or ammonium sulphide. |
| Orange | Full Orange ... | Antimony sulphide ... ... | Antimony chloride and ammonium sulphide. |
| Red ... | Indian Red ... | Iron oxide ... ... ... | Perchloride of iron and ammonia (with subsequent heating). |
| ,, ... | Silver Crimson | Silver chromate ... ... | Silver nitrate and potassium chromate. |
| White ... | Chinese White } Zinc White } | Zinc oxide ... ... ... | Zinc sulphate and caustic soda or ammonia. |
| ,, ... | Lead White } White Lead } | Lead carbonate ... ... | Lead nitrate or acetate and sodium carbonate. |
| ,, ... | Barium White ... | Barium sulphate ... ... | Barium chloride and sodium sulphate. |

**Some easily prepared paint pigments which are produced by simple chemical precipitation.**

# The World's Largest Land Plane




*The latest addition to the Imperial Airways fleet is the Ensign, shown here. It has a top speed of over 200 m.p.h.*

## The Imperial Airways New Fleet of Ensign Air Liners is stated to be the Fastest and Largest in the World.

FOURTEEN great air-liners which will be the largest in regular operation in the world and of which the Ensign is the first, will shortly take their place in Imperial Airways fleet of aircraft and will be designated the "E" class air-liners.

Several will be of a "European" type and will be used on Imperial Airways continental routes. The others, of which the Ensign is one, will be of an "Empire" type and will be specially equipped to work the Empire land-plane services between England and Calcutta which are to be operated in conjunction with the flying-boat services.

The "E" class air-liner marks a further substantial step forward in Imperial Airways policy of operating large aircraft, able by their size and reserve of engine power, to afford the best possible standards of reliability, spaciousness and comfort.

Imperial Airways were not only pioneers of large aircraft, but also of aircraft equipped with four engines, thus giving the best possible guarantee of reliability. The Ensign is equipped with four Armstrong Siddeley "Tiger IX" medium supercharged engines built into the leading edge of the wing and fitted with De Havilland controllable pitch propellers.

### Four Engines

These four engines provide a total of no less than 3,400 h.p. giving ample power reserve and enabling the air-liner to maintain height with full load at 12,500 feet on three engines and at 4,000 feet on two engines only.

This new fleet of aircraft is expected to be the fastest of its size in the world. A feature of the design is the remarkable streamline form which has enabled the constructors to combine speed with size. A top speed of more than 200 m.p.h. has been realised on the Ensign trials.

Fuel tanks are built into the wings and the tankage is sufficient to give the aircraft a wide range, making it possible with slight adjustments of load, to fly 1,000 miles non-stop against a headwind of 40 m.p.h.

The Ensign is a high-wing, cantilever monoplane of all-metal construction. The fuselage is an oval monocoque structure completely covered with metal sheets of light alloy presenting a smooth outer surface. Technically, one of the features of the design is the form of construction used in the wing. This is tapered in plan form and thickness, and is built on a single, rectangular box-spar of corrugated light alloy sheet.

### Increased Wing Area

Split trailing edge flaps are fitted of a type, which, in effect, increase the wing area, being used for increasing lift at take-off and increasing drag, and consequently reducing the speed at landing.

The undercarriage of the Ensign is the largest in the world, and, despite its colossal size, is retractable. It has two single wheels, each of which is fitted with a tyre 6 ft. 3 in. in diameter and 2 ft. 2 in. wide. No aero tyre of these dimensions has ever been manufactured before and they were constructed by the Dunlop Rubber Company. The retracting mechanism is hydraulically operated. The rear strut of each leg folds and the wheels travel backwards and upwards into the engine fairings behind the main plane spars.

Imperial Airways existing liners on European routes have set an example to the world for size, luxury, silence and lack of vibration. These features will be still further advanced in the Ensign and to them will be added the quality of high cruising speed.

The question of eliminating vibration and noise—an important factor in the construction of air-liners—has been the subject of intensive research by experts engaged on the construction of the new air-liners.

Vibrationary noise is frequently transmitted from the engines to the hull through

*The Ensign in flight over the Midlands.*

the wings. This has been obviated on the Ensign by insulating the engines from the wings with Armstrong Siddeley patent flexible engine mountings.

### Noise Suppressors

The problem of extraneous noises has been dealt with in several ways. One prolific cause of noise in aircraft is the high speed of the tips of the propeller-blades, this has been overcome in the new aircraft by arrangements to operate the propellers at comparatively low speeds. New methods of sound proofing have been employed. Special bulkheads which prevent drumming are fitted and specially thickened window glass also assists in keeping the saloons free from extraneous noise.

An additional aid to silence is the placing of the passenger saloons away from that part of the fuselage in line with the engines. This portion of the air-liner contains only the kitchen, the mail and freight holds and lavatories. The interior layout and equipment of the new air-liner has been designed to provide the highest possible standards of comfort, freedom of movement and convenience for passengers.

The "European" type of air-liner will be able to carry up to 40 passengers. Certain modifications will be made in the "Empire" type owing to the necessity of special equipment for journeys of long duration in tropical climates and the carriage of larger loads of mails and 27 passengers will be carried on day flights while, for night journeys, sleeping berths which can be quickly dismantled will be provided for 20.

### Passenger Chairs

The passenger chairs have been designed by experts of Imperial Airways after more than two years of research. These chairs can be adjusted to any position from the almost vertical to the almost horizontal by the passenger while actually seated. Yet they weigh only 19½ pounds—the lightest and yet one of the most comfortable lounge chairs ever constructed.

Each passenger has a table on which meals can be served and on which he can place small personal belongings such as books. By his side will be a light switch controlling a wall light over his table and, just above his head, a small ventilator which he can adjust according to his needs.

Heating and ventilating are under a system of control developed by Sir W. G. Armstrong Whitworth Aircraft Ltd. Fresh, clean air is drawn in around a steam heater operated from the engine exhausts and this will be circulated evenly through all the passenger saloons affording a constant supply of air untainted by engine fumes at an equable temperature.

The interior layout includes several passenger saloons as well as a promenade deck.

Besides the saloons, there are two separate lavatories, a completely equipped kitchen and well-stocked bar, mail and freight holds and even a ship's office. This office will be used by a ship's clerk who will have the duty of checking freight and mail cargoes during flight.

From the kitchen, in accordance with Imperial Airways long-standing practice on their larger aircraft, it is possible to serve seven-course dinners as well as five-course lunches and snacks and drinks of all descriptions.

*The Ensign passing over the old type Imperial Airways liner "Scylla," which she is to replace.*

### THE IMPERIAL "ENSIGN" LAND-PLANE AIR-LINER

**Essential Facts and Figures in a Summarised Form**

1. *There are to be* 14 *of these aircraft in the new fleet.*
2. *They represent a capital investment of* £750,000.
3. *In each air-liner there are three cabins and a promenade. The cabins are* 13 *ft. long and* 8 *ft.* 8 *in. wide. The centre cabin is as much as* 9 *ft.* 2 *in. high.*
4. *The overall length of the air-liner is* 114 *ft.*
5. *The overall height to the top of the airscrew is* 23 *ft.* 6 *in.*
6. *Each air-liner is equipped with four moderately supercharged "Tiger IX" engines built by Messrs. Armstrong Siddeley Motors Ltd.*
7. *These engines provide a maximum power of* 810 *h.p. at* 2,450 *r.p.m. at* 7,000 *ft., and* 880 *h.p. at* 2,375 *r.p.m. for "take-off."*
8. *The maximum speed of the air-liner is over* 200 *m.p.h. at* 7,000 *ft.*
9. *The maximum cruising speed is approximately* 170 *m.p.h.; the minimum flying speed is* 70 *m.p.h.*
10. *Rate of climb at sea level (with airscrews in coarse pitch) is about* 800 *ft. min.*
11. *The ceiling, fully loaded, is about* 20,000 *ft.*
12. *Time to "take-off," when fully loaded, is* 20 *secs.*
13. *Weight fully loaded,* 21.6 *tons.*
14. *Normal range in still air is* 860 *miles.*
15. *Maximum capacity of fuel tanks,* 670 *gallons, i.e., over* 2.25 *tons.*
16. *Payload, plus crew, is* 9,000 *lb. (over* 4 *tons).*
17. *Normal crew of five, i.e., Captain, First-Officer, Wireless Operator, Flight-Clerk and Steward.*
18. *The wing loading is approximately* 20 *lb. per sq. ft.*
19. *Hydraulically operated wing flaps are fitted.*
20. *Marconi radio equipment with direction finding equipment is installed.*
21. *The short and medium wave telegraphy transmitter works on wavelengths of* 16.9 *to* 75 *metres, and* 600 *to* 1,100 *metres. The output of the former is* 100 *watts and the latter* 120 *watts.*
22. *The telephony transmitter works on the medium wave band.*
23. *The Sperry automatic pilot is fitted.*
24. *Two landing lamps are fitted in the leading edge of the wing.*
25. *The structure of the air-liner is mainly of Alclad, an alloy of aluminium.*
26. *The landing-gear is retractable, being hydraulically operated and fitted with an emergency lowering gear.*
27. *The landing wheels of the retractable undercarriage are* 6 *ft.* 6 *in. in diameter.*

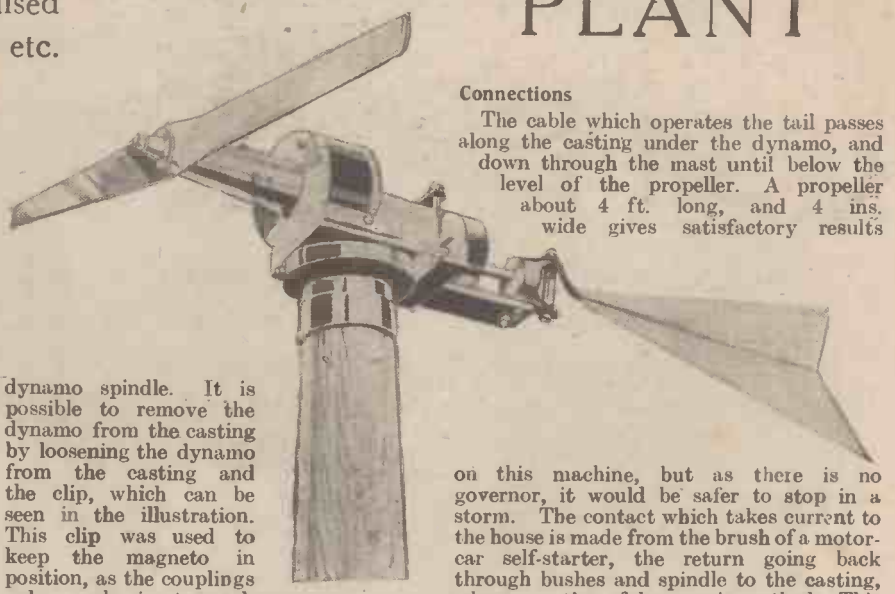
# A WIND DRIVEN LIGHTING PLANT

## How The Wind Can Be Utilised To Charge Wireless Batteries, etc.

THE accompanying illustration shows an efficient wind-driven lighting plant I have built, and which is suitable for charging wireless batteries, etc.

### Constructional Details

This plant, which works at six volts, comprises a Lucas 12-volt dynamo, taken from an old motor-car lighting set, and a six-volt cut-out. The casting on which the dynamo is mounted is an old gas engine valve guide inverted into a horizontal position, the spindle being arranged to fit into a bush in the end of the mast, and resting on the thrust race. The spindle which carries the propeller is an old model Ford camshaft, with the cams turned off. This spindle is fitted with two ball bearings, and also a race to take the thrust of the propeller. The timing gear, which is retained on the camshaft, acts as an oil splash which lubricates the propeller shaft driving end of dynamo, and coupling, which connects the shaft to the dynamo. This coupling is taken from an old motor-cycle gear-box; one half is screwed on the camshaft outside the timing gear instead of a nut, and the other half is fixed to the dynamo spindle. It is possible to remove the dynamo from the casting by loosening the dynamo from the casting and the clip, which can be seen in the illustration. This clip was used to keep the magneto in position, as the couplings only push in to each other. It is possible to remove the dynamo without disturbing the propeller or tail.



### Connections

The cable which operates the tail passes along the casting under the dynamo, and down through the mast until below the level of the propeller. A propeller about 4 ft. long, and 4 ins. wide gives satisfactory results on this machine, but as there is no governor, it would be safer to stop in a storm. The contact which takes current to the house is made from the brush of a motor-car self-starter, the return going back through bushes and spindle to the casting, where negative of dynamo is earthed. This machine has been working quite a long time without giving any trouble.

J. D.

# *An "O" Gauge Garden Railway*

## *A Remarkable Garden Railway Which Has Been Constructed By One Of Our Readers, Mr. T. G. Mackenzie.*

*Showing a bridge and part of the track.*

IT is perhaps unusual for an "O" gauge railway to be built in the open, as it is thought that this gauge will not stand up to weather conditions, but the railway shown in the accompanying illustrations, has, for the last eight years, endured all kinds of weather without suffering any ill effects.

The garden measures 40 ft. x 38 ft., and the track makes a complete circle round it with a branch line running down the side of the house and into the garage. Altogether there is about 80 yards of track, the rails are of steel, and as keyed-on chairs are used, it would not be a difficult task to replace the rails should they become rusty. Concrete is used for ballast.

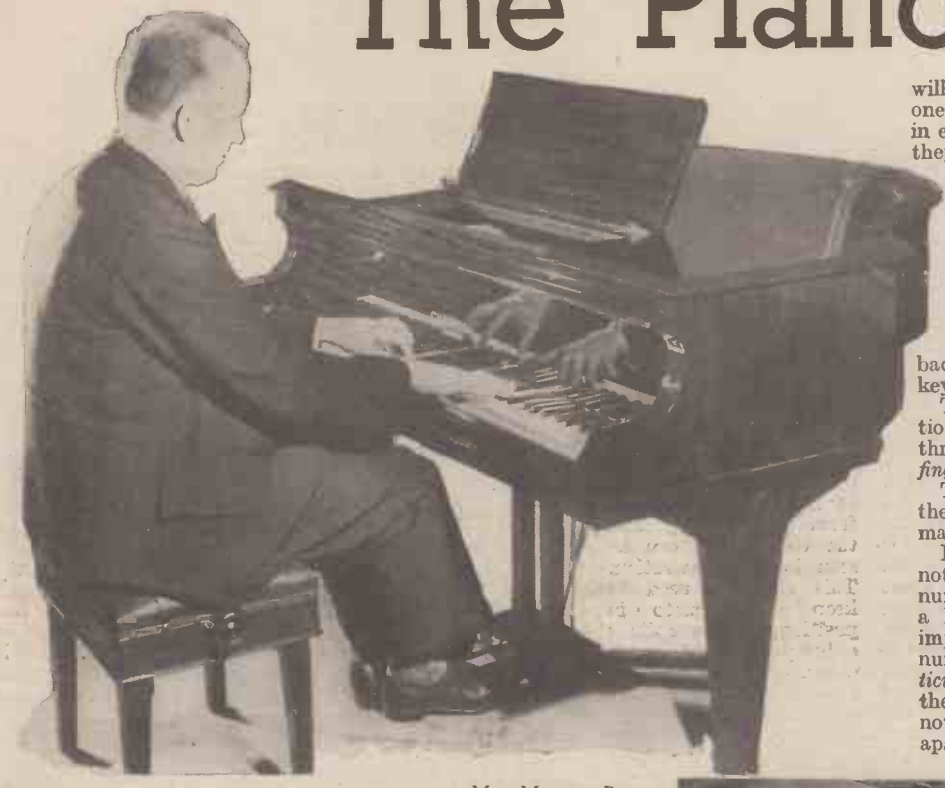
### The Layout

When planning the layout the first job was to dig a hole in the corner of the garden, and a concrete viaduct 8 ft. x 3 ft. was built across it at the highest point. The line then runs through a tunnel 4 ft. long, which has concrete entrances, and is brick-lined. There is a manhole on the top of the "hill" for track repairs. Next comes a gorge spanned with a 3 ft. 6 in. long concrete bridge, and there is also a metal swing bridge 3 ft. 6 in. long across the garden path. This is made of light section sheet iron and tinplate. It has been found that the best protection for this is red lead and boiled oil. On the other side of the garden is a lake spanned by a two-arch concrete bridge.

In one of the illustrations it will be seen that a picture has been painted on asbestos sheets, the foreground being planted with moss and rock plants. The tunnel entrance, ruin, bridge and walls are made from broken roofing tiles with cement mortar. On two sides of the garden the line runs amongst, and is backed by rockeries. Really beautiful effects may be accomplished by building rock cuttings and rugged cliffs, etc., whilst the judicious use of rock plants will ensure continuous colour for most of the year.

*A picture painted on abestos sheets which adds realism to the railway.*

# The Piano—A New



*Mr. Maurice Reeve at the piano.*

THE excerpt on page 151 is taken from the Toccatta by Paradies, and should serve as a useful type of score on which to illustrate the art of reading.

Keep the eyes on the score; the keyboard is the fingers' job.

Look ahead of the fingers—even half a bar's margin should be sufficient to avoid such traps as the change of clef in bar 12.

Whilst the fingers are joining the notes in the method described, the eyes do the same with the notes on the score. Never forget the twin representation of the notes, both of which must be kept in perfect unison if the fingers are to have any real chance. Let one get apart from the other, and the result is an inevitable breakdown.

**An Example**

This process turns a score into a sort of imaginary weather or temperature chart, marking the rise and fall of the notes.

A glance at the example given on page 151 will reveal that, if one looks ahead of what one is playing, the top and bottom notes in each hand are very prominent, and that they can therefore be very easily linked up in the mind's eye. You have then only got to familiarise yourself with the appearance of intervals and distances between notes on the paper (that is, distances of three, four or five notes, etc., between any two notes) and the fingers have to gain the knack of measuring off these distances or intervals on the keyboard. (Again we get back to the inseparable unity of score and keyboard.)

The example is marked with the calculations one should make as one proceeds through the piece, *all in advance of the fingers*, so that the fingers get every chance.

The key should be "heard" by adding the accidental D sharp to the signature, making it into E major.

Note the intervals between two space notes or two line notes are an *odd* number of notes apart; when between a line and a space note, as in the all-important octave, they must be an *even* number apart. One should become *particularly* familiar with the appearance of the octave interval, both when the two notes occur together and at any distance apart. This interval, together with ledger

*The right-hand illustration shows the chord F, A, D and F, with the correct fingering, 1, 2, 4, 5 (right-hand) 5, 4, 2, 1 (left-hand). The two lower illustrations show the frequently used, but quite wrong, fingerings, 1, 2, 3, 5; 5, 3, 2, 1 and 1, 3, 4, 5 and 5, 4, 3, 1, respectively.*

# Method of Learning to Play It

lines, are perhaps the reader's chief difficulty, but they needn't be under this system of inter-relation and absolute unity of the note on the keyboard and the score, and linking up of the notes with each other in both places.

### Counting

By far the surest way of accounting for every fraction of time—especially those in the form of rests or dots, the absence of which ruins the balance and style of a piece—is to make the value of your beat the same as that of the smallest fraction of time which can be seen by glancing through your piece (not reckoning some minute fraction of which there may be only one or two in the whole work).

Until great experience can be gained, and absolute accuracy reached, in giving large value notes every one of the fractions which go to make up their whole without counting them out, they are bound to be cut short where they follow smaller valued notes. The excerpt on page 148 is typical of thousands of cases. Not one beginner in a hundred would make the last bar worth twelve-twelfths—like the first bar. The unaccompanied dotted note would bound to be hurried—the accompanied one in bar 2 is a relatively easy matter. But if a


*This is a full compass Grand Piano, by the famous firm of Chappell.*

**MAURICE REEVE,** THE FAMOUS PIANIST, TEACHES YOU HOW TO PLAY THE PIANO BY A NEW AND MODERN METHOD. MR. REEVE ALSO REGULARLY BROADCASTS FROM THE B.B.C.

**This Month the Author Describes the Principles of Reading.**

semiquaver beat is adopted, giving two beats to the quaver, three to the dotted quaver and four to the crotchet, no one of any ordinary intelligence can fail to account for every fraction.

### "Black Notes," Sharps and Flats

Don't forget that we have to "hear" values as well as sound. We cannot measure the duration of a note, or rest, with anything but our ears!

Do not fall into the erroneous belief that the more flats or sharps there are in a key the harder it must, therefore, be. As explained under the heading of notation, every scale sequence is the same. We get our difference of key by choosing a different note to start on, and the accidentals are then automatically brought in. Follow the sequence and get thoroughly familiar with the tonality that sequence produces, and the "black notes" should cause you no trouble at all.

### Dotted Notes

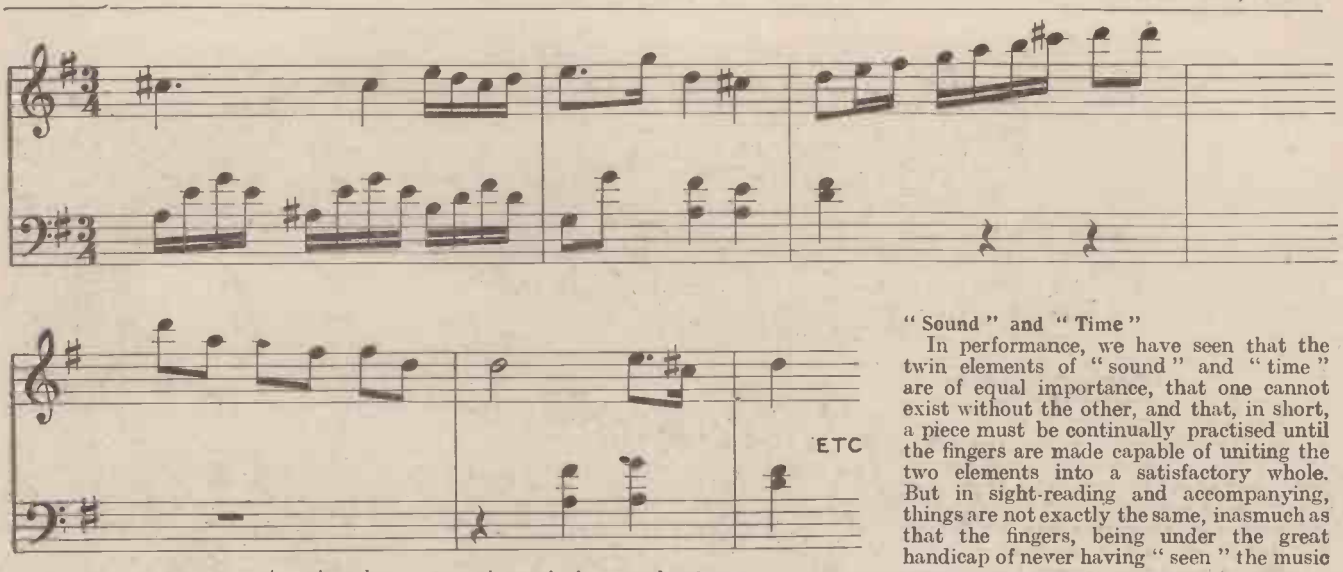
Hundreds of these are lost by inexperienced readers, before they have gained the knack of splitting up units of time into specified fractions. A very simple rule will avoid countless mistakes. When the value of the note which is dotted and of the beat which you have chosen for counting are the same, the dot falls on the second beat. I am of course referring to unaccompanied dots; if all beats were "played," our counting problem would be solved, or rather it would never have existed.

The illustration at the foot of page 151 will serve.

### Accuracy of Beat

Any beat which is divided up into a fraction, of which there are too few to warrant one adopting it as the beat throughout the movement, is easily given accuracy by adding the word "and." Thus in the aforementioned sketch the beats would go: 1 one, two, three, four, five, six *and* 1 one, etc., the "six and," of course, being said in the same space of time as each of the other numerals. The "six" coincides with the dot, and the "and" with the semiquaver,

*The familiar first inversion is even more wrongly fingered. The left-hand illustration shows the correct fingering, 1, 2, 4, 5, and 5, 4, 2, 1. The right-hand illustration shows the wrong way, 1, 2, 3, 5 and 5, 3, 2, 1. The Rule to be remembered is never to let the 3rd and 4th fingers span an interval of a third if avoidable, and never a fourth under any circumstances.*




*A simple reading exercise with special reference to dotted notes.*

the dot (half a quaver) and the semiquaver note making up one quaver beat.

Never "read" two notes with slack and flabby fingers and wrists, just because it is "reading". Use your fingers in one way only, the proper way, at all times.

Never "read" new music with separate hands; it leads nowhere. One might as well try to learn to walk on one leg at a time. Work with separate hands is necessary for the mastering of special difficulties,

*(Right) Study showing 4th and 5th fingers well braced up for obtaining maximum strength in the weak fingers.*

*(Left) Showing a scale being practised with balanced coins to ensure pure finger work without any unwanted "aid" from the forearm or arm. If these are used the coins will quickly fall off.*

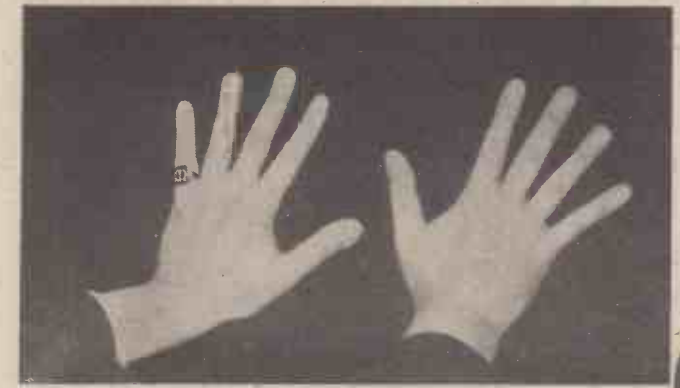
but for reading, for getting to know a new piece, it is so much waste of time. When you come to put the two hands together you will find yourself just where you were at first—all your difficulties will still lie ahead of you.

### "Sound" and "Time"

In performance, we have seen that the twin elements of "sound" and "time" are of equal importance, that one cannot exist without the other, and that, in short, a piece must be continually practised until the fingers are made capable of uniting the two elements into a satisfactory whole. But in sight-reading and accompanying, things are not exactly the same, inasmuch as that the fingers, being under the great handicap of never having "seen" the music before, find that at various difficult parts of the piece they cannot play *all* the notes *correctly* in the specified rhythmic measure. Now, where the difference comes in is that if one of the two elements has to be sacrificed, it must not be the time and rhythm.

The notes must go, all of them if necessary, but the time must remain unflagging and relentless. The way to maintain continuity of sound in an emergency like this is to sacrifice the inner harmony, or voices, and to read the outside, or soprano and bass, voices only until such time as the fingers can regain their grip on things. You will then be pretty sure of playing the voice most approximating to the melody (soprano

(*Continued on page* 151)

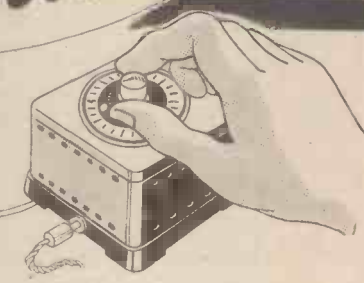


*The study of the hands, extended on a flat surface, is meant to show the great space between the first (thumb) and second fingers compared to that between any other two fingers In practice, it is equal to the span of all the other fingers combined. The writer can comfortably strike an octave with his first two fingers. Consequently the phrase "consecutive fingers", so often used herein, and the prohibition against their use in the fingering of intervals, does not apply to the 1st and 2nd fingers.*

*The action of a grand piano.*

# 100% Remote Control

*For realism*



# TRIX TWIN RAILWAYS are in a class by themselves!


For the very first time you can run miniature trains just like a real railway—by 100 per cent. REMOTE CONTROL. Two trains can be run on one track, at different speeds, in different directions, separately or together. The wonderful new Trix features include :

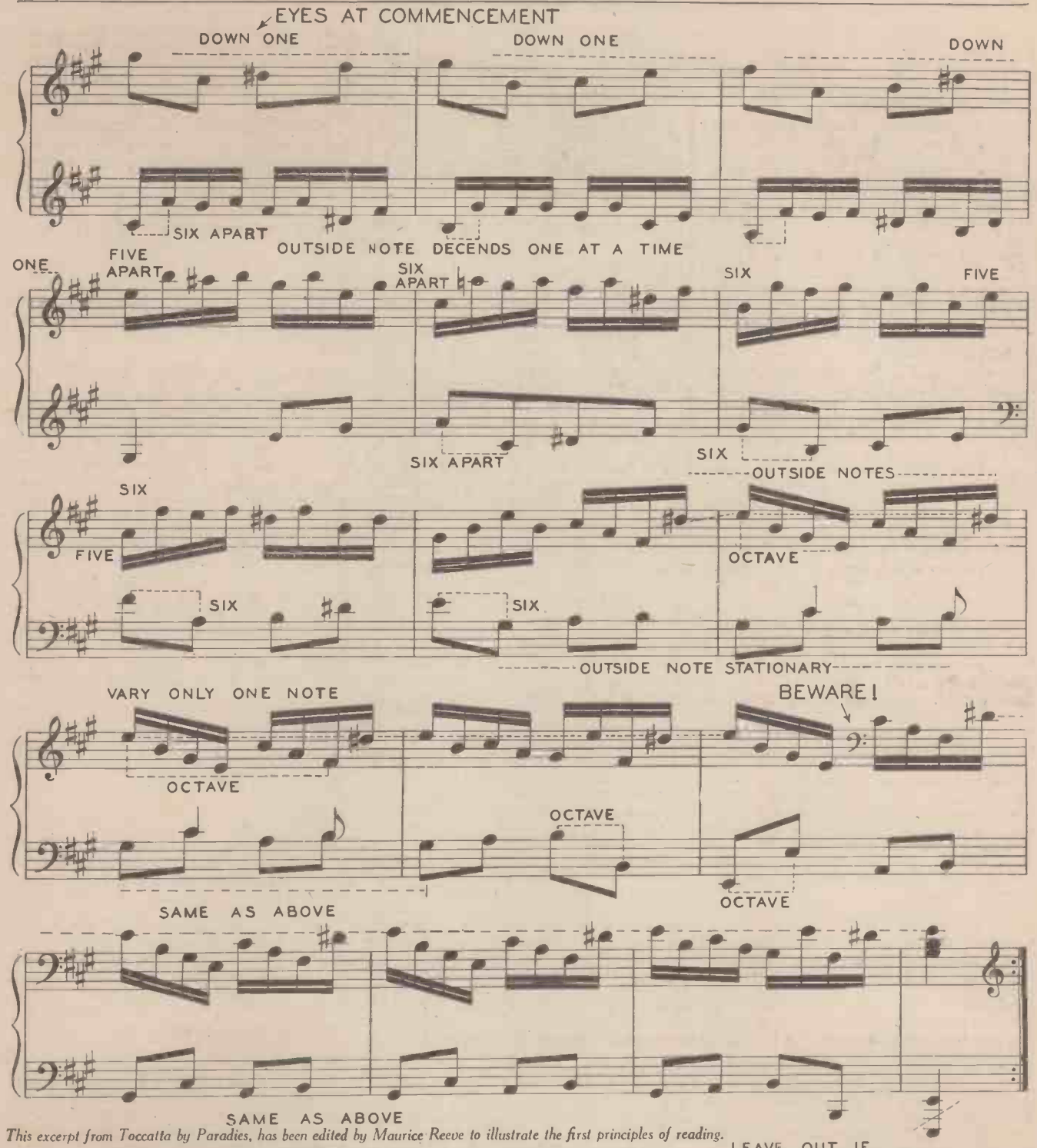
- **100 per cent. Remote Control,** including Remote Control shunting and marshalling.
- **Scale Models** designed by Bassett-Lowke, of "Pacific" type 4-6-2 locos : "Flying Scotsman" and "Princess" class.
- **Remote Control Uncoupling** of Engine at any point of the track—an exclusive Trix feature.
- **Remote Control Signals** with light.
- **Super Controller,** giving greater flexibility and sensitivity of control.

*Get the Catalogue, price 2d. from all good stores and dealers everywhere. If any difficulty write to address below.*

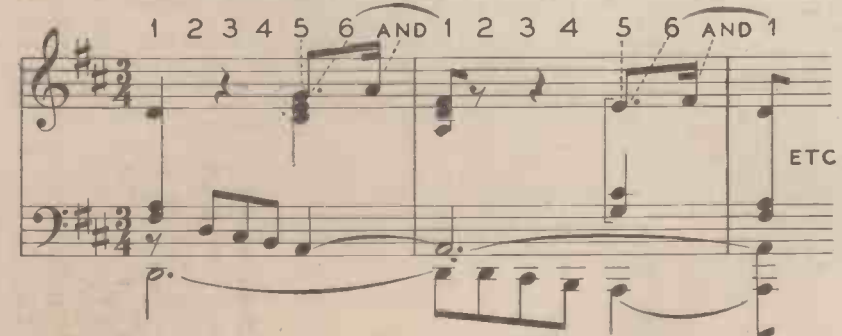
TTR
TRIX TWIN RAILWAY

# TRIX
# TWIN RAILWAY

TRIX LIMITED, DEPT. M.2, 45, CLERKENWELL ROAD, LONDON, E.C.1




*This excerpt from Toccatta by Paradies, has been edited by Maurice Reeve to illustrate the first principles of reading.*




*This illustration indicates the value of dotted notes. A semiquaver beat here, although the movement is slow. is obviously too small a time fraction, as there are not enough of them to make it worth while.*

LEAVE OUT IF DIFFICULT TO READ LEARN AFTER

(*Continued from page* 148)

voice) and the bass voice will give you the widest compass. Of course, naturally, all the " body " of the music, the harmony, colour, variety, are lost, but that is better than losing the whole thing ! If the time goes, nobody can possibly keep with you and everything comes to a standstill.

The best, in fact the only, way to overcome any possibility of these catastrophes happening is to give yourself the biggest possible " margin of safety " by practising reading with the eye as far ahead of the fingers as you can achieve.

# NEW INVENTIONS

### Yet Another Gas Mask

THE United States Patent Office has accepted an application for what is termed a "Universal Facepiece for Gas Masks." This anti-gas respirator has been designed to fit exactly all sizes and shapes of adult faces. There are two double attachment straps on each side. One strap is just above and the other is immediately below the centre of the lenses. These straps serve to wrinkle the facepiece inwardly when under tension. Apart from the intended orifice, the mask more or less hermetically seals the face of the wearer.

### Anti-Side-Slip Bowl

IT is said that the first cooks were kings, but, in ordinary domestic establishments, woman is the Queen of the Kitchen. Consequently it is natural for a married lady to be the designer of an improved mixing bowl for pastry. The *raison d'etre* of this bowl is to enable the process known as whipping to be performed conveniently. When whipping, cooks often tilt the basin, which is subject to slip. To prevent this, the inventress has devised a bowl with one or more lateral faces on the outer side, on which the bowl can securely rest during the mixing operation. There will, therefore, be no excuse for a side-slip.

### A Thing of Beauty and Light

AN intriguing method of enhancing the attractiveness of a mirror is the subject of an invention for which a patent has been applied. Not only is the device a thing of beauty, but it is a source of illumination. Furnished with a number of transparent bosses, facets and other projecting ornamentation, means is provided for illuminating the article, so that light shines through the transparent parts. Apart from its decorative value, the mirror is qualified to throw light upon the countenance of the lady or gentleman who gazes into it. And, as a consequence, the looking-glass will reflect the beauty of the beholder—if any.

### Burstproof Rubber Bottles

WITH the advent of Jack Frost, his implacable enemy, the hot-water bottle, makes it re-appearance. Now, a hot-water bottle, like fire, is a good servant but a bad master. The bursting of a tyre on the road is an annoying circumstance, but the bursting of a hot-water bottle, in bed, may be a disaster. For instance, a friend of mine, one more or less Arctic night, retired to rest in the society of that genial companion, his rubber bottle replete with boiling water. Owing to some defect, the heated liquid made an assault upon his legs which they mercilessly scalded. As he was in the house alone, the sequel might have been tragic. Fortunately he was a chemist and had the knowledge and means necessary for administering suitable treatment. This accident stresses the importance of one's hot-water bottle being, as far as possible, unpuncturable.

The British Patent Office has recently had submitted to it an improvement in hot-water bottles, air cushions, etc. The aim of the inventor has been to produce articles of this description with seams which are both burstproof and leak-proof. His plan is to join rubber sheets at the edges with a strip of fabric coated with rubber solution. This he re-inforces with unvulcanised rubber coated with the same solution. Let us hope the allied edges will live together happily for ever afterwards.



### Lost For Ever

THE subject of burst rubber brings to my mind the tragedy of an air cushion. While on a cruise, a widow was accustomed to recline her platinum blonde permanent waves against a cushion filled with air. One sunny morning, she left that fated air cushion upon the seat of her deck-chair. During her absence, two boisterous cruisers indulged in a little horseplay. One of the men hit his boon companion on the head with the cushion. And with a full-blown pop, it burst. When the widow returned she found that her once rotund air-cushion was transformed into a pancake. The men profusely apologized and undertook to buy her another cushion at the first port at which the liner touched. But the widow was inconsolable. She stated that her loss was irreparable. Her late husband had blown that cushion up with his now departed breath !

### The God of the Winds

THE gigantic organ, with which Mr. Reginald Foort is touring the country, has a 30 h.p. blower. This moves me to comment upon the remarkable achievements of the inventor during recent years, as regards the mechanical blowing of the King of Instruments. In the days of yore, the wind was raised by a humble individual known as the organ blower. His monotonous duty was to work a handle up and down behind a screen.

The cinema musicians, whose occupation has been affected by the coming of the talkies, is not the only victim of modern invention. The mechanical blowing apparatus threatens to render the organ blower as extinct as the bellows with which our grandmothers produced a genial glow on the hearth. However, he is still pumping away in village churches. The average organ blower has never heard of Archimedes, but he realizes the power of the lever, for, the length of the handle of his apparatus determines the amount of exertion necessary. By the way, a wheel instead of a handle has, in the past, been attached to the blowing apparatus. And it is on record that one such wheel disconnected itself and rotated down the aisle of the church.

The mechanical blower is a godsend to the organist. It is to the credit of the inventor and the manufacturer that it rarely fails to perform its duty. Under the old system, the human element was sometimes late or not there and, when present, occasionally failed. Like Aeolus, the blower was indeed the god of the winds. Not a sound was heard until he provided a favourable breeze. To-day, thanks to the inventive power of man, all the organist has to do is to switch on the wind, as he does the electric light.

### The Elusive Keyhole

THE keyhole, especially when the morning is in swaddling clothes, has been a source of inconvenience to many a rollicking convivialist. But even the absolutely sober find it not easy to insert the latchkey, owing to the narrow aperture of locks such as that of the Yale type. In the dark, they usually make more than one attempt before the key is successfully pushed home.

To obviate this disadvantage, an inventor has devised a special escutcheon cap for door locks. It comprises a dished plate with a keyhole in the deepest part. And it is adapted to be fixed in front of the lock, and to rotate with the key. The principle of this accommodating gadget is that of a funnel, which provides a wide aperture for the pouring of liquids into the narrow neck of a jar.

Not only will this device make for the easy entrance of the key, but, incidentally, it will prevent much impatient and worse language.

### Big Drum Beaten by Foot

I OBSERVE that, on the other side of the Atlantic, a new bass drum beater has been patented. According to Greek mythology, there was a giant named Briareus who had a hundred hands—a counterpart, on a large scale, of the centipede. Such a person would have been useful in those bands in which a musician is expected to play more than one instrument. But the average human being has only one pair of hands, as he occasionally impatiently reminds annoyers. Therefore, sometimes it is necessary to bring the foot into requisition. In the case of the above-mentioned device for beating the big drum, there is what is termed a "beater ball," which I presume answers the purpose of the knob on the end of a drum-stick. And the contrivance also includes a foot-board. The performer thereby is enabled to make foot-notes.

### Frozen Music

APROPOS of choked motor horns, those familiar with the adventures of that famous traveller, Baron Munchausen—the super-romancer—will remember the story of his frozen horn. He relates that one bitterly cold day when the temperature was well below zero, his coach horn was so affected by the frost that not a note sounded from its bell mouth. But when, in the evening, he placed the horn beside the blazing hearth, the larynx of the trumpet was thawed. And then the retarded blasts emanated from the instrument, as though it were a radiogram. Verily, Baron Munchausen was an inventor. In sooth, he out-Ananiased Ananias.

### "Comfy" for Chicks

THE poultry keeper will be interested in a new device which has for its object the warming of chicks at night. The inventor has borne in mind that the use of lamps for this purpose has more than one disadvantage. First, lamps cost money both to buy and keep burning. Then, there is a danger of overheating and suffocating the juvenile fowls. And, in case of fire, there is a possibility of premature roast chicken.

The device in question comprises a frame having supporting legs, and there is a canopy of soft material suspended in such a manner that it sags. Under this, the chicks can comfortably sleep. There is a platform above, upon which the more ambitious birds can roost, if they so desire. And there are slits in the sides of this dormitory, by means of which the youthful denizens of the poultry farm can make their exits and their entrances.

DYNAMO

# MASTERS OF MECHANICS

## No. 40—Wilbur and Orville Wright, Pioneers of Mechanical Flight

*(Left) Orville Wright and (right) Wilbur Wright.*

TOWARDS the end of the nineteenth century several daring enthusiasts were attempting to solve the problem of mechanical flight. It was an age-long problem, for, no doubt, the most primitive races of mankind had, time and time again, produced individuals who had looked up at the birds and had longed to emulate their apparently effortless flight.

Noteworthy among all the early pioneers of mechanical flight was a German, one Otto Lilienthal, who, more than any other single individual, gave himself up to the problem of flying and who eventually produced a number of successful gliders.

### Lilienthal

It is to Lilienthal, indeed, that the present-day general appearance of the aeroplane is due, for the Wright brothers copied the general designs of his gliders. Had Lilienthal lived, there is little doubt that he would have been one of the first—if not *the* first—to take an engined glider through the air under its own power. Indeed, Lilienthal had actually designed and constructed such a glider and was on the point of trying it out when, for some reason or other, he suddenly decided to give one of his older engineless gliders a last trial. He did so on the morning of the 9th of August, 1896, taking off near the village of Rhinow in the German province of Brandenburg. For a time all went well, but afterwards, without any warning, a sudden gust of wind caught the glider and carried it upwards. Lilienthal failed to steady the machine, with the result that he crashed to earth from a height of 50 feet, breaking his spine and dying shortly afterwards.

### The Two Wrights

At this time there lived in far-off America two brothers, Wilbur and Orville Wright. They were sons of a certain Milton Wright, whose ancestors had originally emigrated from England and settled near Dayton in the American State of Ohio. Wilbur was born near Newcastle, Indiana, on 16th April, 1867, his brother, Orville being born at Dayton, Ohio, on 19th August, 1871.

Right through their boyhood, their youth and their subsequent careers, Wilbur and Orville Wright were inseparable companions. During the early part of their lives they had tried their hands at more than one occupation. One of them, for instance, had been a journalist and a reporter, and the other had actually run a small news-sheet of his own.

In 1896 the brothers Wright were joint proprietors of a small bicycle-making business in Dayton. They had formed a small company for the purpose and were, at last, making headway.

In the autumn of the year, they read of Lilienthal's accidental death. Curiously enough, it set them thinking, so much so, indeed, that almost immediately they began to turn their attentions to the many problems involved in mechanical flight.

### Studying Books

The Wright brothers began by studying every book which they could obtain on the subject of gliding and flying. In America at that time were two gliding enthusiasts, Octave Chanute and Professor Samuel Pierpoint Langley, of the Smithsonian Institution, Washington. These two experimenters had succeeded in obtaining a good deal of data relating to gliding flight. Their work was eagerly reviewed by the Wrights who, before long, came to the conclusion, as Lilienthal had done before them, that mechanical flight was well within the bounds of practical possibility and that it needed merely the obtaining of the right conditions for the solution of the problem.

The practical experiments of the brothers Wright began in 1900 at a remote place known as Kitty Hawk on the sandy coast of North Carolina. They chose this spot partly in view of its remoteness and partly because the American Weather Bureau at Washington had advised them that thereabouts they might expect to find the gentle winds of constant force which they needed for their gliding experiments.

The first glider constructed by the brothers Wright was of the biplane type originated by Lilienthal. It had a total wing surface of 165 square feet. Lilienthal had controlled the motion of his gliders by practised and almost instinctive movements of his body. The Wright brothers, however, went one better than this. They arranged for the operator of the glider to remain still and to control its movements by pulling wires which operated movable elevators or vanes fixed at the front and sides of the glider.

### The First Glider

At first the Wright glider was made captive at the end of a long rope. Eventually, however, the brothers took the risk of gliding freely on it from the summit of a big sand hill near Kitty Hawk which went by the somewhat ominous name of Kill Devil.

The Kill Devil gliding experiments were perfectly successful. More than a hundred free glides were made, and at the end of the summer of 1900 the Wright brothers returned to their Dayton home in high spirits.

The next year they returned to Kitty Hawk, taking with them a larger glider with a wing area of 308 square feet which they had constructed in their Dayton cycle shops over the winter. This glider, however, proved not to be so manageable as the smaller one. Orville Wright remained optimistic, but Wilbur was very greatly discouraged. Indeed, he even went so far as to predict that although men might sometime learn to fly, it would not be in their time.

During the following winter, the brothers made a number of experiments in a wind

*Wilbur Wright flying at Le Mans, France, in 1908.*

tunnel of their own construction. The problem they were trying to solve was that of the glider's stability. By means of attaching elevators or movable vanes in front of and behind their gliders they had already solved the problem of fore and aft stability, but that of the lateral or sidewise balance of their gliders still remained unsolved.

### "Warping" Wings

At last, in the summer of 1902 they journeyed once more to Kitty Hawk, taking with them this time a glider having "warping wings," the extremities of which were capable of being upturned or twisted by means of a control operated by the pilot in flight. The glider, also, was given a rear vertical vane which could be moved sidewise in a manner similar to a ship's rudder.

This glider proved to be perfectly successful. After making 700 successful glides in it, the Wright brothers felt that they had solved the problem of the essential stability of their aircraft. All they now wanted was an engine which would propel the plane through the air.

Funds, however, were running short. Despite money which had been given them by their father, Milton Wright, in spite even of many financial contributions which had been made by their sister, a school teacher, Wilbur and Orville Wright were now coming up against that problem which has beset the paths of so many pioneers and inventors—the problem of financing their experiments.

One or two influential friends, however, were eventually forthcoming and the experiments continued.

The Wrights wanted an engine to power their successful glider. There was no one they knew who could make it, so they had to design and construct it themselves. It took them more than a year to do so, but eventually the task was completed and the engine took the form of a 30-h.p. internal combustion unit, of weight approximately 210 lbs. which, when fixed in the plane, drove directly two propellors at a speed of 350 revs. per minute.

### First Power-Driven Plane

This, the first power-driven aeroplane of the Wrights, made its appearance at Kitty Hawk in 1903. The propellors were fitted to the rear of the machine and revolved in opposite directions. Since the machine did not possess an under-carriage, it had to be launched into the air by the combined aid of a number of mechanics who gave it an initial push along a monorail track.

The machine was tried out on December 17th, 1903. Several people had been invited to attend the trial, but, owing to the coldness of the day, only five spectators turned up.

After a run of 40 ft. along the monorail track, the plane rose to a height of 10 ft. above the ground and flew horizontally for a few seconds at a speed of ten miles an hour.

Immediately succeeding flights were longer. Indeed, at the fourth trial, the plane (which had been christened *The Flier*) remained in the air for 59 seconds, during which time it attained a height of 852 ft. and travelled more than half a mile in a horizontal direction.

Thus was the first successful human flight accomplished. The world, at first, refused to believe the news that two obscure American brothers had, in a remote district of their country, solved the problem of mechanical flight before a handful of witnesses on a particularly cold winter's morning. All the same, it was true, and, eventually, some recognition began to be paid to the intrepid Wright brothers.

A new aeroplane was built during 1904, one which was heavier and stronger than the original *Flier*. This was tried out at Simms Station, some eight miles east of Dayton, Ohio, in the spring of 1904. The plane was stable enough, but the engine performed badly, so that no spectacular reports emanated from the meeting.

### 100 Flights

Despite their unsatisfactory engine, the Wright brothers performed a hundred engine-power flights during 1904, at each flight learning something new about the many problems of aerial navigation.

Strangely enough, the experiments of the Wrights attracted little attention. For three consecutive years, the brothers endeavoured to commercialise their aeroplane and to sell manufacturing licences for the construction of their machines, but with only a very moderate degree of success.

Now that the aeroplane had become an accomplished fact, nobody seemed to want it or to have any faith in it.

Three times the Wright brothers offered their invention to the British Government, and three times the British Government rejected the offer. Neither would the French Government show any interest in the invention, but, eventually, the United States Government showed a mild interest and announced that its military experts would consider the plane when it could be proved that the machine would remain in the air for an hour or more and when it could be manœuvred easily in any direction and made to land at its starting-point.

On September 9th, 1908, Orville Wright fulfilled these conditions, remaining in the air for more than an hour. Three days afterwards, however, whilst flying with an American army expert, Lieutenant Selfridge, as a passenger, the plane crashed badly. Orville was severely injured, and his passenger, Selfridge, was killed outright, an incident which, of course, did not by any means contribute to the popularity of the invention.

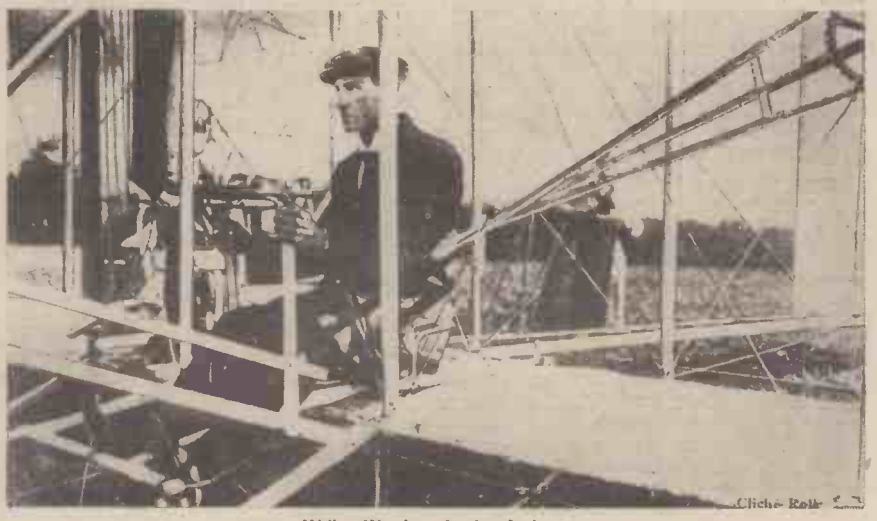
### Trials in France

Meanwhile, Wilbur Wright had proceeded to France to continue trials with one of his planes and, also, to sell the manufacturing rights for that country. In France he made the acquaintance of Léon Bollée, a noted motor-car maker of Le Mans. Bollée seems to have been amazed with the crude and primitive engine with which Wright had powered his plane. At once he began to improve the Wright engine, making alterations here, modifications there, until, eventually, a much superior engine was obtained.

As a consequence, therefore, the flights which Wilbur Wright made during his visit to France in 1908 increased from a matter of minutes to one of hours. A lasting friendship sprung up between Wright and the amiable, good-hearted Bollée. It was one, indeed, which contributed much to the cause of the aeroplane, for, owing to the superior engines designed and manufactured at the Bollée factory, Wright was able to make his first public flight in France in the August of 1908, on which occasion he covered a distance of nearly three miles in three minutes.

### Steady Progress

From now onwards, aeroplane design and construction began to make steady progress. Aeroplane races, trials and other events were organised in increasing numbers both in America and in France and at this date, also, England entered the field, many historic flights being made, also, in our country.



*Wilbur Wright in his first biplane.*

Success had now come to the Wright brothers and honours were showered upon them. They cared little for the latter, however, their main object in life being the development of the aeroplane and the introduction of commercial flying.

### Death of Wilbur Wright

To what extent their pioneer efforts have been developed the reader well knows. In their business and commercial dealings Wilbur took the lead. Although the brothers received due material rewards for their work, they never attained the degree of wealthiness which more avaricious men might have gained. For, after all, the Wrights were experimenters first, commercial men afterwards.

Wilbur Wright died of typhoid fever on May 20th, 1912—just at the time when the aeroplane was coming into its own and was being universally recognised as an adjunct to civilisation.

Orville Wright still lives on his bachelor life at Dayton, Ohio. Pioneer of the world's flying enterprises, he bears many honours, civil and academic, but these rest lightly upon him, for he realises that his true memorial, and also his brother's, is to be seen daily above almost every part of the world.

*See special article on page 173*

# Laws of Liquids

## The Phenomena Of Fluids Explained In Straightforward Language

MATTER is divided up into three main categories, solid, liquid and gaseous, which, under given conditions, are all interchangeable one into the other.

In many respects, however, it is the liquid state of matter which has given the physicist the greatest amount of food for thought and has provided the widest scope for the exercise of scientific ingenuity, for in a sense a liquid tends to combine many of the properties of a gas with some of those of a solid.

The constituent particles or molecules of a gas have very little attraction for one another. Consequently, when a quantity of gas is introduced into a vacuous space, the molecules of the gas immediately fly apart, each of them seeking to remove itself to as great a distance from its neighbour as possible. That is why a volume of gas always completely "fills" any given space.

### Pull of Gravity

With a liquid, however, matters are different. It is true that the particles or molecules of a liquid possess some of the extreme mobility of those of a gas, but there is a very much greater attraction between them which results in their always tending to keep together under their own mutual attractions and under, also, the external attraction of gravity.

Pour water into a vessel. It at once sinks to the bottom, assumes the shape of the vessel's cross-section and at once presents a level upward surface.

Gravity, we have just seen, is the root cause of a liquid thus accommodating itself to the cross-sectional shape of a vessel and if, by any chance, the force of gravity were to be removed suddenly, the mass of liquid in the vessel would immediately fly upwards, its constituent particles separating themselves and flying apart in a similar manner to the particles of a gas.

Could we, by means of some superlatively powerful ultra-microscope, observe the behaviour of the particles of a basin of water as it rests apparently so still and motionless upon the table, an astonishing sight would greet our eyes. For, under these imaginary conditions, we should witness the particles of the water (or of any other liquid, for that matter) in violent motion here, there and everywhere. The spaces between each liquid particle are not very great. Consequently, the various particles during their process of darting here and there in a haphazard manner beneath the surface of the liquid, meet with many collisions with other liquid particles. But an ordinary collision like this is nothing to a molecule and after each head-on hit, we should observe that the particle went merrily on its headlong course as if nothing whatever had happened to it, apart from a chance deflection of its path of motion.

### Through a Microscope

And so, with our ultra-ultra microscope, we should actually witness the precise conditions of affairs in a liquid which physicists have been able to prove by deductive and mathematical reasoning. As a matter of act, it is, even at the present day, possible to see the direct mechanical effects of this liquid molecular motion. If the reader has a fairly high-powered microscope, let him place a drop or two of water upon a glass slide and in this water place a minute quantity of gamboge or lycopodium powder, afterwards sealing up the slide and submitting it to microscopical examination. In these conditions, he will witness a ceaseless motion of the individual particles of powder which have been suspended in the water. These particles are floating in the water and, not being soluble, are being tossed about here and there like a number of floating corks by the ceaseless motions of the water molecules themselves.

This ceaseless movement of the insoluble powder particles is called "Brownian motion" on account of its having first been observed by a botanist, Robert Brown, in 1827, and it is really one of our nearest approaches to perpetual motion, since the mad whirling dance of the particles continues for an indefinite time.

In more recent years, it has been possible to witness actual particles of gold, silver and other metals in this ceaseless motion, thus proving that any insoluble material whose particles are small enough is subject to Brownian movement.

*Water, when applied to an oily surface, tends to break up into globules which present a minimum surface to external influences.*

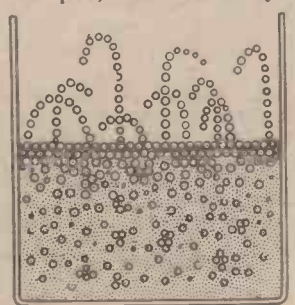
*A "drop-making" machine, used for the experimental study of liquid drops.*

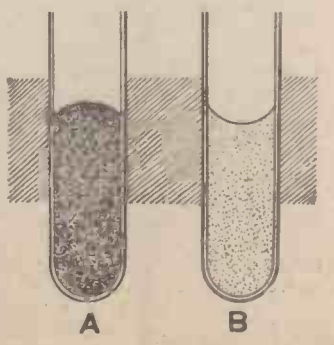
### Minute in Size

Actually, the diameter of an average sized liquid particle is about one-two hundred millionth of an inch, smaller, indeed, than the waves of light, which fact makes it impossible for us ever to view these particles directly. Even the spaces between the particles are, on an average, only about one-five hundred thousandth of an inch across and in a single minute drop of water there are about fifty million molecules. Figures such as these, which strain our powers of imagination, are soundly deduced ones and they enable us to form at least some estimate of the almost inconceivably minute dimensions of these particles.

Yet it is these liquid particles which, as we shall see, perform much of the work of mankind and upon whose readily available energy much of our present-day civilisation rests.

Consider again for a moment our vessel of water resting on a table. The constituent particles of the water are hurling themselves through the mass of the liquid in every possible direction. At times, some of the particles escape from the liquid and dart away from its surface in rocket-like trajectories. Some of these escaped particles, fall back on the surface of the liquid like a spent rocket, and are thus reabsorbed into it. Others, however, having greater impetus, and travelling with a speed approximating to twelve or fifteen miles a minute, escape entirely from the attractive range of the liquid surface and fly off into the space above the liquids, mingling with the particles of air and behaving to all intents and purposes just as if they were actual particles of gas.






(*Left*) *A liquid in a container exposed to the air, showing constituent molecules of liquid, some escaping from the surface of the liquid and giving rise to evaporation.* (*Right*) *Mercury in a tube* (*A*) *tends to pull its surface out of contact with the glass; water* (*B*), *on the other hand, "wets" the sides of the tube and tends to cling to them.*

### Diminish in Volume

Thus we see that a liquid with a freely exposed surface, always tends to diminish in volume in consequence of this continual escape of its particles. We call this process evaporation.

All liquids evaporate, the lighter ones more quickly, the heavier ones more slowly. Even that heaviest of all normal liquids, mercury or quicksilver, evaporates slowly at ordinary temperatures, as anyone can prove for himself by hanging a piece of gold leaf over a bowl of mercury and observing the slow "silvering" of the gold.

When we increase the temperature of a liquid, what we actually do is to increase the energy of motion of its constituent particles, so that they are thus able to hurl themselves away from the liquid surface with greater ease and in greater numbers.

Hence we see now exactly why a liquid evaporates more quickly the hotter it becomes.

If we go on increasing the temperature of the liquid, we eventually reach a point at which all the heat energy is utilised in separating all the liquid particles and in hurling them off into space. This is the boiling point of the liquid, the temperature at which it is completely changed into vapour or gas.

The expansive force derived by molecules escaping from a boiling liquid is colossal. One volume of water, when boiled, is converted into no less than approximately 1,600 volumes of steam, or gaseous water and if this steam is still further heated its volume undergoes a further increase.

### Force of Steam

It will be obvious now why the force of steam is practically irresistible and why so much power can be obtained from it by means of the steam engine, since when we supply heat to a liquid we increase the energy of its molecules, making them fly farther and farther apart despite all obstacles which may be placed in their way.

Conversely, when we abstract heat from a liquid, its evaporation rate decreases. The liquid particles crowd closer and closer together as a result of their slow-down motions and, ultimately, the huddled-up molecules rub shoulders, as it were, with one another, the result being that the liquid freezes and becomes solid, losing all its liquid characteristics.

Most solids, ordinarily speaking, do not evaporate. Hence, solid water (ice) would retain its mass without loss for a perfectly indefinite time if kept at a temperature below freezing point.

One of the most striking physical differences between liquids and gases is that, although the latter may readily be compressed, all liquids are practically completely incompressible. Compared to the spaces existing between the particles of a gas, the intra-molecular spaces of a liquid are very small indeed. Thus, when external pressure is applied, it becomes physically impossible for a liquid to occupy a volume very much smaller than its normal one.

Upon this incompressibility of liquids, the well-known system of hydraulic pressure is based. An hydraulic press is simply a means whereby pressure applied to a liquid is transmitted by it unabsorbed and is delivered up at the surface of a larger area of the same liquid.

Another curious thing about liquids is that when perfectly free to behave as they like, they all tend to present a minimum amount of surface. Now the figure which has mathematically the smallest extent of surface for a given volume is the sphere, and it is the sphere which a liquid will always tend to assume when it is freed from unequal gravitational effects and other influences.

### Metallic Mercury

You are probably aware, for instance, of the behaviour of metallic mercury when spilled upon a perfectly flat, polished surface. It breaks up into silvery, mobile drops which are exceedingly difficult to catch and to pick up. Each drop of mercury is nearly spherical, being only flattened at its area of contact with the table.

Water flung on to a flat, heated surface or on to a surface dusted with fine powder does the same thing also. Were it not for the downwards pull of gravity, all liquid drops would be perfectly spherical in shape, instead of being pear-shaped as they usually are.

This ever-present tendency for liquids to present the smallest possible area of surface makes them behave as if they were covered at their surfaces with a stretched elastic skin. Due to molecular forces, there is always present at the surface of liquids a tensional effect, known as "surface-tension". This surface tension resists the rupture of the liquid surface and is responsible for a large number of varying effects connected with liquids.

### "Wetness"

What we may term the "wetness" of liquids forms an exceedingly interesting study. Oils are the wettest of liquids, because they tend to spread in very fine films over surfaces of objects and to cling to the latter tenaciously. On the other hand, mercury is a "dry" liquid. Its surface tension is such that the surface of mercury seems always to be pulled away, as it were, from objects with which it is brought into contact. Note mercury in a vessel or, better still, in a barometer tube. Its upper surface, curves away from the glass. Water surfaces, on the other hand, tend to cling to the surfaces with which they make contact, provided that the latter are clean. Thus if you dip your finger in water, it comes out wet, whereas a finger dipped in mercury is never "wetted" by that liquid.

If water be applied to a greasy surface, it breaks up into a number of globules, refusing to "wet" the surface in the ordinary manner. This is because water and oil are liquids of two different degrees of "wetness" and oil being the wetter liquid of the two, clings preferentially to the surface, the water then tending, in virtue of its natural law, to present the smallest possible surface and thus assuming globular form.

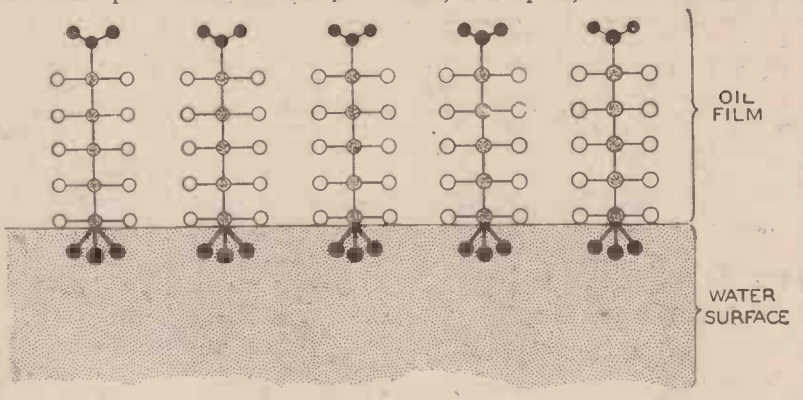
When oil is flung on water, it spreads itself out on the surface of the water in the form of an exceedingly fine film.

Take a large bowl of water and dust it with some very light powder, such as a cosmetic powder, which will float on the liquid surface. Now take a glass or metal rod, dip it into a bottle of oil, wipe away the surplus oil from the rod and then dip the latter gently below the water. Instantly at each entry of the rod into the water the surface-floating powder will recede from the area of contact between rod and water, forming little circular clear spaces on the powdered water surface. This is because the oil has taken up its position on the water surface, forming a fine film which has driven away the particles of powder.

### Oil

Oil, when it is applied to a water surface, actually wets the water, just as water wets the surface of clean glass. Now one of the most remarkable things which has recently been discovered in connection with liquids is that when oil is applied to a water surface, it tends to form a film which is actually only one molecule thick.

Oil molecules consist of a central backbone, so to speak, of linked carbon atoms, having hydrogen atoms at their sides, and other atomic groupings at both ends of the chain, the whole being not unlike a sort of molecular centipede, with its backbone, legs, head and tail.




*Showing the manner in which the molecules in a film of oil erect themselves above the surface of the water.*

### Affinity for Water

Now the end atomic groupings of these oil molecules have a strong affinity for water. Consequently, when oil floats on the surface of water, each oil molecule digs its head (or its tail) into the water surface, the rest of the molecule standing upright above the water level.

Thus, a film of oil, one molecule thick, on a water surface, may be compared to a field of wheat with its innumerable straight stems standing erect from the soil level.

Each of these oil molecules is about one two-millionth of an inch in length, this measurement constituting approximately the thickness of the oil film on the water surface.

Winds do not "catch" oil surfaces to anything like the extent which they do unprotected water surfaces. Here, therefore, is the explanation of the effect of "oil on troubled waters." Floating on wind-disturbed waters, even a one molecule thick layer of oil can prevent wind from getting a "grip" on the water surface. Thus it affects a comparative calm over the water area on which it floats.

# WHEELS FOR MODELS

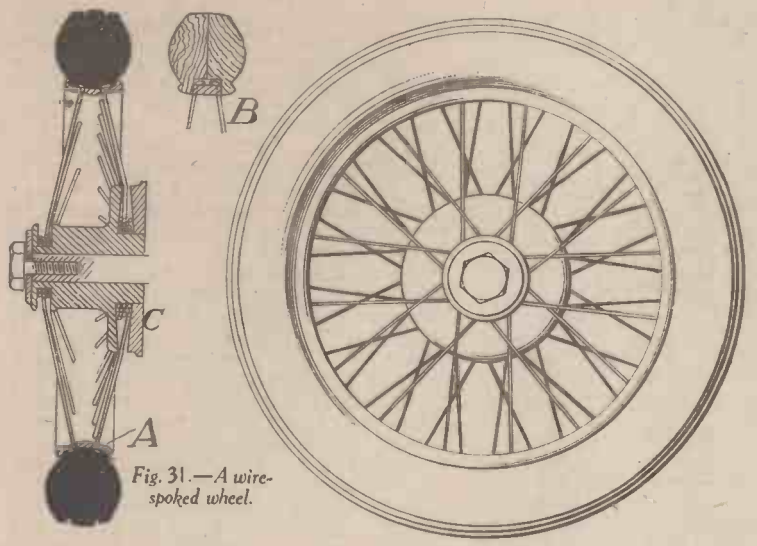



*Fig. 31.—A wire-spoked wheel.*

*By "Handyman"*

## The Sixth Article of a Short Series dealing with the Construction of Wheels Suitable for every Type of Model. This Month We Deal with Bicycle and Wire-Spoked Wheels.

FIG. 31 shows a cross section and a face elevation of a modern wheel; the cross section showing the grooves turned in the hub. These grooves must be deep and the one at the back of the wheel, which has to accommodate twice the number of wires, must either be turned wider at the bottom, i.e., at the smallest diameter, than at the top, or have a separate collar put on, as shown at C.

Hubs should be of brass or gunmetal as must be also the rims, unless the latter are spun from large diameter copper tubing.

### The Rims

The first thing to do will be to decide what is to be done about tyres. They can be bought in several different diameters, and the reader who is going to build a model of a car would be well advised to buy his tyres before commencing construction and let the size of them settle the scale of his model.

Having obtained the tyres, the wheel rims must be made to suit. The section called for is shown at A, Fig. 31.

Suppose, however, that the model-maker thinks he will make wooden tyres and paint them to look like rubber, then the metal rim need only be a flat band, or, more correctly, a very short cylinder, and the tyre will be turned in two pieces, as shown at B, the turned wood being made to include not only the tyre, but the continuation on each side of the metal so as to complete the correct form of the rim.

Whichever kind of rim is adopted it must be very accurately divided out, and a scribed mark made where each saw-cut is to come. The front and back edges should be carefully marked in relation to each other. Then proceed to make the cuts to take the wire, the depth of every cut being made the same. The thickness of the saw blade to be used will depend upon the diameter of the wire. In any case it will be a metal-worker's slitting saw and, of course, it must be thicker than the wire.

### Wire Spokes and the Jig

For the spokes of small wheels nothing can be better than tinned iron wire of the kind which is used by florists, and may be bought on reels or coiled on cards. For large-scale wheels copper or brass wire may be used.

Having made all the rims and the same number of hubs, a jig will now have to be made in which the wheels are to be built. Fig. 32 shows, in three views, this jig and the manner in which it is to be used. It is turned from a piece of hard wood, oak or mahogany. At A is such a piece of wood, in which a hole is bored; into this hole a dowel of very hard wood is glued and driven. Boxwood will be by far the best for this dowel.

The jig is then mounted in the lathe and turned to the shape shown at B and C. The object of the dowel will now be apparent. When the jig is in the lathe the dowel is reduced in diameter, and the object of turning the pin of the dowel at the same time as the rebate in which the rim will rest is to ensure the pin, which must be turned to exactly the same diameter as will be the axle ends, being dead true with the rebate; thus, the ultimate truth of the wheel after building will be ensured.

### Order of Spoking

It does not matter very materially in what order the spokes are put in; that is to say, how far around the groove in the hub the first spoke is carried before it leaves the hub to form the second spoke, but it is important that every pair of spokes should observe the same order and make the same angle with each other. Nevertheless, although it is not material, no better arrangement could be adopted than that shown in Fig. 33, where A shows the first pair, making an angle of about 90 degrees. The sketch also shows, by numbers against the notches, the positions of all other pairs.

At sketch B the first five pairs are indicated by different kinds of dot-and-dash,

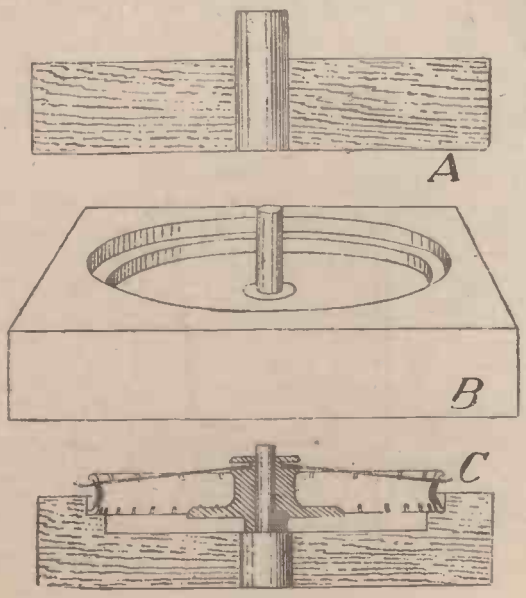



*Fig. 32.—A jig for building wire wheels.*

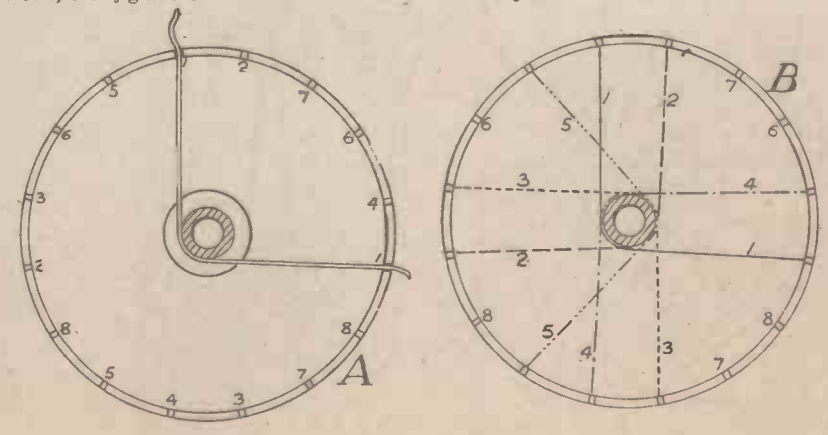



*Fig. 33.—The order of spoking.*

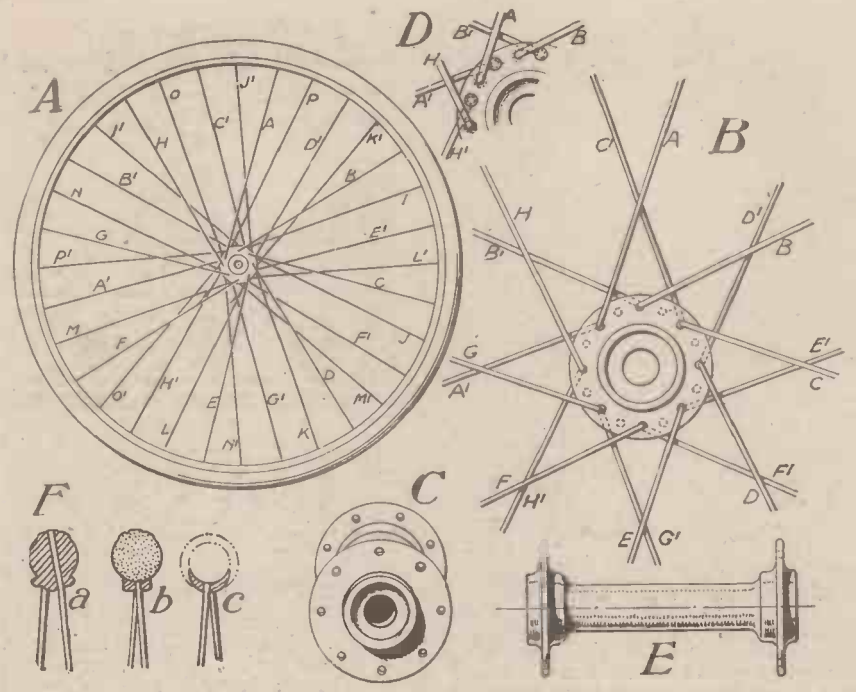



*Fig. 34.—Details of a model bicycle wheel.*

or dotted, lines, pair No. 1 being drawn in a solid or unbroken line. No. 1 pair is put in first, then No. 2 and so on in numerical order.

After all the spokes are in the front face they are to be soldered to the rim all round; the wheel is then carefully lifted off the jig, reversed, i.e., put on again, upside down, and the back of the wheel is spoked, soldered at the rim and all ends of wire cut off and bent back as at A and B, Fig. 31. Finally, the grooves in the hub are filled up with solder, or, if the reader is doubtful of his skill with the soldering iron, with plaster, and the saw-cuts in the rim likewise. In the latter case one notch should be filled, with solder, at a time, so as not to disturb the spokes.

### Bicycle Wheel Models

There are, of course, other wire-spoked wheels beside those of motor-cars, which are sometimes called for in models, and, as the writer has at times had to deal with such, it is proposed to show the simplified methods adopted in making them. First we will take the bicycle wheel with laced spokes. By the way, a model of an ordinary pedal cycle is a thing which is seldom made, and yet it makes a most attractive thing in miniature, especially if it is really well made and finished, and it does not involve a great amount of labour.

The hub may be turned from brass rod, the flanges drilled for the spokes, and the centre drilled through for a plain bearing —ball bearings, would be unnecessary. The tyre can be either turned solid, in brass, with the rim, or it can be a round rubber ring stretched over a hollow in the rim. If the scale is small, say from one-eighth to one-twelfth full size, tinned iron wire can be used for spokes.

### The Spoke Arrangement

Fig. 34 shows full details for such a wheel. In the bicycle wheel, unlike that of the motor car, the spokes, where they are secured in the hub, have a buttoned end which is visible, as at D in the drawing.

It will be seen that only every alternate spoke has the button on the outside of the hub and, moreover, that the pairs of spokes, with their heads, come so close together that the appearance of the wheel would be practically the same if the pairs were not separate spokes, but made of one length of wire passing through one hole only in the flange of the hub, instead of through two holes. So in the model wheel that is what the writer suggests should be done.

The drawing A (Fig. 34) shows the whole wheel with all the spokes complete and B shows an enlarged view of the centre. In both of these views the spokes which will be continuous to represent a pair are given the same reference letters. Thus, commencing with the first spoke lettered A, we have A1 as its continuation. Moving round from left to right we have B and continuation B1, and so on. We, therefore, have eight spokes and eight continuations on each side of the wheel. This involves drilling each flange with eight holes only, instead of sixteen as would be the case if we copied exactly the sketch D—the full-size wheel.

It will be noticed by examining drawing A—or the wheel of a full-size bicycle—that the spokes on one side of the wheel fall exactly one-fourth of the circumferential distance between those on the other side, thus, between A and B (ignoring D1 and K1), which are tangent at the opposite angle) we have spoke P. Between D and E we have spoke K, and so on. From this it will be seen that the holes on one side of the hub must be drilled to break step with those on the other, as shown at C, and by tiny dotted circles in sketch B. Sketch E shows the profile form of the hub.

### Tyres and Rims

Drawing F shows cross sections of three forms of rim, it also shows at *a* a tyre which is turned in metal in one piece with the rim. B shows the modern light rectangular rim with a rubber ring stretched on for a tyre; whilst C is a rim, also to take a rubber tyre, which can be made by bending a piece of copper tubing to a circle and turning away in the lathe as indicated.

### Perambulator Wheels

Wheels with direct spokes, such as are shown in Fig. 35, are the most simple of all wire wheels to make. The miniature baby carriages which the writer's firm, Twining Model, Ltd., made for presentation to H.M. the Queen's Dolls' House, were fitted with wheels constructed almost exactly as shown.

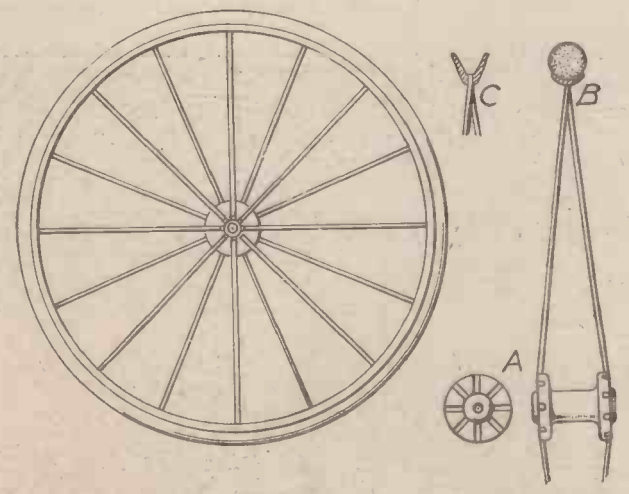



*Fig. 35.—A perambulator wheel.*

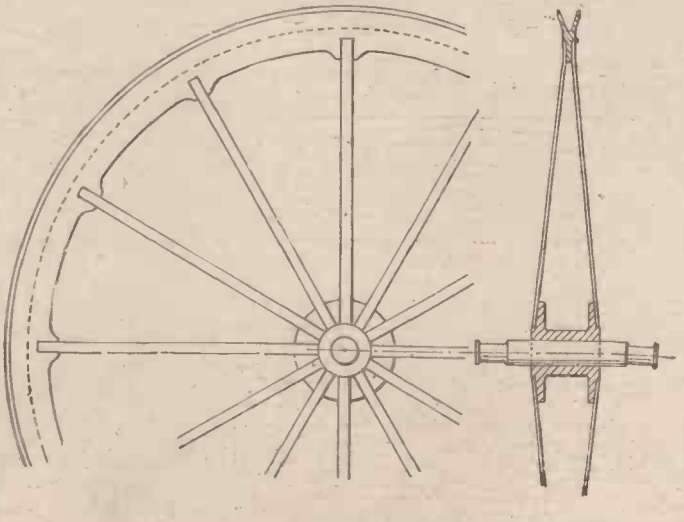


*Fig. 36.—A colliery pithead pulley.*

*Pattern to show groundwork of lines.*

*An example of Japanese design.*

*Some artistic borders.*

# PAINTING ON GLASS

## An Interesting and Inexpensive Hobby

By "HANDYMAN"

THE idea of painting on glass often suggests difficulties to the uninitiated, but when once it is realised that the painting itself is as simple as painting on paper, the chief obstacle is removed. As a hobby it is attractive and inexpensive. Glass candlesticks, goblets, trinket sets, flower vases, and glass for the table can be decorated, but it is advisable to start experimenting on flat surfaces, such as ash and pin-trays, flat-lidded boxes, and plates.

**Tools and Materials**

Use small, smooth sable brushes which are in no way worn and always have an odd piece of glass handy on which to try the colour. A sheet of tracing paper will be needed, and choice of colour depends upon whether a transparent or opaque effect is desired. Well-known firms supply specially-prepared colours for glass-painting, but all good enamels or porcelain paints will adhere to the surface without firing.

Designs can be enriched by the use of untarnishable gold or silver mixed with a quick-drying medium which is supplied with the gold. For transparent painting, the coloured varnishes sold in bottles can be recommended. Some students use artists' oil colours with "transfix" medium, but oil colour requires very careful handling, as it so frequently blurs at the edges or runs into an adjoining colour. It should be tested and left to dry on a piece of glass before starting work on the finished article. Very satisfactory results can be obtained with inexpensive plain or coloured glass which has a smooth surface.

**Design**

As in every other handicraft, simplicity of design applies to first efforts. Four favourite arrangements of patterns for glass are the massed effect, the border, the spray and the all-over design. Every unit of the pattern should be, like a stencil plate, a piece by itself, so that the colours do not touch each other. Another colour can only be used next to, or over the first when it is dry. A black outline is sometimes used to force up the colour. Spotting, if used discriminately, is very decorative. With a little practice it can be done by allowing the paint or enamel to drip from the end of a brush or thin wooden stick.

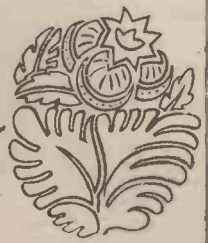
For an all-over design, masses of flowers linked up with a network of fine lines, make a very attractive pattern. Lines and spots can also be used for space-filling, provided a very fine brush is used for small spotting. All who have the opportunity should study Japanese design, as it is a source from which much can be learnt.

Trace your drawings very carefully, cut out the tracing and gum it with clear gum on the underside of the article to be painted. Sometimes the tracing is kept in position by strips of stamp-paper or adhesive gummed tape instead. This method is an invaluable guide to all who have not the necessary confidence to paint straight on to the glass. When glass is for table use, the designs should be gummed to the underside or outside of the glass (excepting plate borders) to avoid contact with food. It is quite a good plan to make a tracing of separate flowers and leaves and arrange them when they are cut up. When a motif is to be repeated, unstick the tracing and rearrange it in the position required, taking care to space evenly. Outlining can be done with a mapping pen, but keep in mind the hardness of the glass and do not press too heavily on the nib. Encre grasse (an oil-colour ink) is sometimes used for this purpose to avoid streaky effects. Do not go over the same ground twice whilst it is still wet. If the colour goes over the outline wipe it off before it dries, as when dry it is very difficult to remove. The surface which is to be painted must be perfectly clean so that the colour will take. It should be washed in warm water or wiped over with a rag dipped in methylated spirit. Shaded effects in colour should be avoided, as they are inartistic. When the colour is quite dry, wipe with a chamois leather and polish with a soft rag, or wash in warm soap and water.

*A neat flower design.*

*A simple design.*

*A spray design.*



*Conventional treatment.*



*Naturalistic treatment.*

*A massed arrangement.*

# A Small Power Press

**This Device Is Intended For Light Stamping And Perforating On Thin Metal, And Will Be Found Useful For Stamping Small Parts Out Of Metal Strip.**

THE small power press shown, is intended for light stamping and perforating on thin metal for repetition work, and will be found useful where a large number of small parts—such as bronze contact fingers, commutator strips, bearing shims, etc., have to be stamped out of metal strip. It is intended to be driven by the lathe headstock and is designed for a 4-in. lathe. In use, the lathe is put into back gear and the largest step of the mandrel belt pulley is used so as to get the lowest possible speed.

It is attached to the lathe bed by two ½-in. bolts passing through holes in the base and between the "ways" of the lathe bed; cross bars being provided as washers below and holding the tool tight on the lathe bed.

### Simple Operation

The operation of the tool is simple. The circular ram A is fitted in the vertical bore of the main iron casting, a close sliding fit. A yoke B (shown in plan view and section inset) is a tight fit on the ram and has a hardened trunnion C projecting from it. This trunnion also locates the yoke on the ram and acts as a stud bearing for the steel connecting rod D by means of which the press is driven from a second trunnion pin on the special lathe mandrel screwed flange plate E.

The yoke sides at XX (section inset at E1), embrace the sides of the main casting (as seen at XX in the plan view, Fig. 3). The yoke has a 1-in. hole to fit the ram tightly and the trunnion pin, ⅝ in. in diameter, has a tapered end driven through the yoke and pinned as seen in the inset sectional view at E. Thus the double purpose of securing the trunnion pin and the guide yoke is attained. The sides of the yoke, guided by the sides of the main casting, ensure against the ram turning in its circular guides and allow us to get a guided ram without resorting to a square cross section which requires expensive machining of ram and ram guides. This is thus avoided.

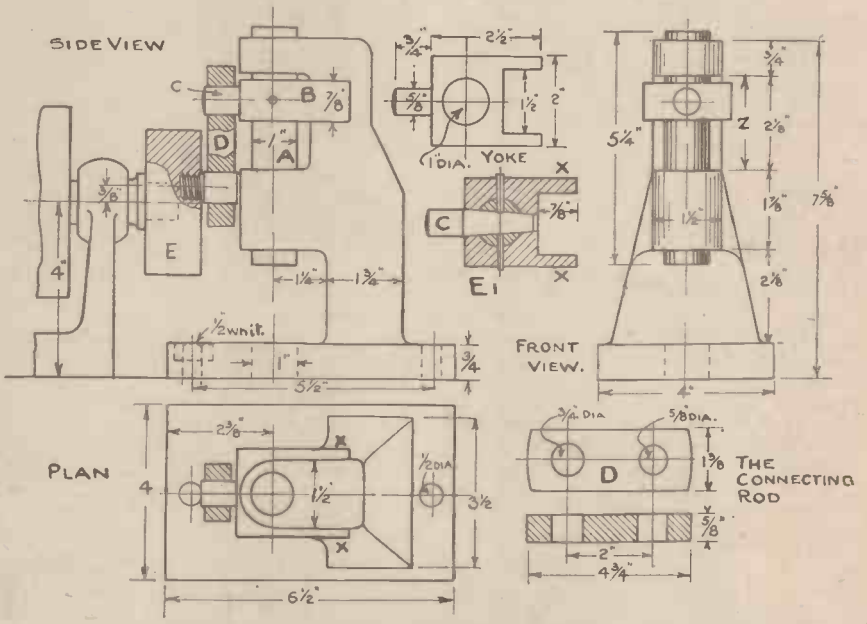
The tool is driven by the connecting rod D from a trunnion similar to the trunnion on the yoke. This trunnion is of hardened steel and threaded with a fine thread and a parallel portion into the flange E screwed on the lathe mandrel nose.

### Stroke of the Ram

The distance of this trunnion or stud from the centre of the lathe axis determines the stroke of the ram, which will be twice the offset distance of the trunnion. The drawing shows ⅜ in. offset giving the ram a ¾ in. stroke. The trunnion on the lathe mandrel is so near the centre that the hole to take it would intersect the thread on the mandrel nose if the flange were thin. Therefore the flange is made thick enough to allow its front face to stand ¼ in. proud of the end of the lathe mandrel nose.

The connecting rod is of cast steel with ⅝-in. and ¾-in. holes parallel with each other at each end and 2 in. centre to centre apart. (See inset front and sectional views.) The rod is ⅝ in. thick and 1⅜ in. wide and the ends are rounded to a diameter struck from each hole centre. A central screw and a washer can be put in each trunnion to hold the connecting rod endways. But there is no tendency for it to move endways and this is more or less a precaution against side strain than anything else.

The design can be followed to suit any lathe of any height by increasing the dimension Z, Fig. 2, and altering the length of the connecting rod—all other dimensions remaining the same except, of course, overall height and the length of the ram. The overall height given is for a 4-in. lathe and works out at 7⅞ in. The casting is in iron from a pattern in wood. No core boxes are needed. The casting is bored vertically to take the 1 in. diameter Bessemer bar which forms the press ram. This latter is quite parallel, 5¼ in. long and has a 7/16-in. parallel hole 1¼ in. long axially at the bottom to take the punches. A ¼-in. Whitworth threaded hole accommodates a grub screw which holds the punch.




*Figs. 1, 2 and 3.—A side, front and plan view of the power press.*

The ram bearing is in two halves, an upper and a lower, bored out of the solid casting. The pattern for this main casting is made of a block of wood mortised and tenoned into the ¾ in. thick bed plate which is 4 ins. wide and 6½ in. long.

### No Core Boxes

No core boxes are required since the bore for the ram will be bored out of the solid. The casting is filed up flat at the bottom and then bolted on to the lathe face-plate with the axis of the bore (scribed on the top end) running dead true. A drill can be fed up by the back centre and then the bore bored out with a boring tool. The bore extends through the bed so that it will be advisable to pack the casting up on the face-plate with a ¼-in. hardwood board between to allow the tool through without catching the face-plate.

The yoke B is made out of a piece of ⅝ in. by 2 in. mild steel bar. Or it can be cast from a pattern.

To ensure that the trunnion is square with the hole for the ram, it is bolted to an angle-plate by a bolt through the jaw end and the taper recess for the taper pin turned.

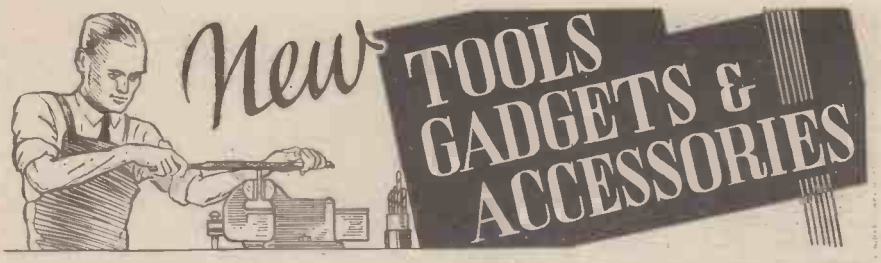
The trunnion C (inset) is turned from cast steel and driven in after the ram has been placed in position in the yoke and in its bearings. Then a ⅛-in. hole is drilled horizontally through yoke and ram and trunnion, reamered with a taper reamer and a taper pin driven right through. This is seen in the sectional view at E1.

The connecting rod is, as previously mentioned, of cast steel. It should be chucked on the face-plate to bore the two end holes parallel with each other—a separate chucking for each hole. This will ensure their being parallel. They should be very carefully bored to fit the trunnion tight. They will be eased later. Then the connecting rod is heated to a good red, quenched and the ends heated till a golden straw colour and quenched again.

### The Trunnions

The trunnions will be run in the lathe and polished with emery till they fit the holes in the connecting rod a good working fit. The holes in the base can be used for hardened bushes of different inside diameters to act as dies for circular punches carried in the ram.

To punch other shapes a die can be made of ½-in. cast steel and held down on the base by dogs held at opposite corners by set screws through holes drilled and tapped in the base at suitable positions for different jobs, and as required. The punches are held in the ram by bedding up to a shoulder on the punch and a flat on the side locates them against turning. A grub screw (¼-in. fine thread), of tempered steel is used against the flat on the punch and its head is rounded to the radius of the ram so that it can offer no obstruction to the ram going up in its bottom bearing, but is available for a screw-driver when the ram is down.




*The address of the makers of any device described below will be sent on application to the Editor, "Practical Mechanics," Tower House, Southampton Street, Strand, W.C.2.*

## A Useful Handlamp

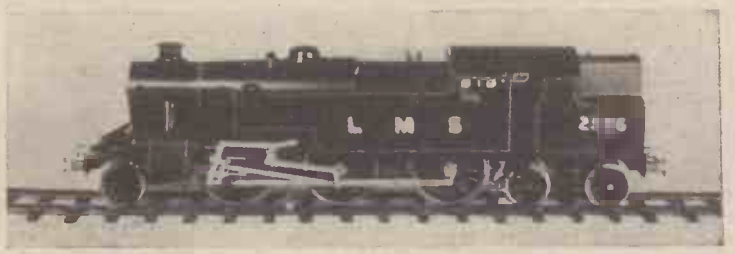
THE Britannia handlamp, shown on this page, is a very attractive proposition for a wide variety of purposes where reliability is of particular importance. It is exceedingly robust in construction, being made of steel throughout, and will stand up to rough usage without injury. The steel battery with which it is fitted will provide 20 hours continuous bright light from a 0.5-amp. bulb on a single charge. The battery is non-spillable, being fitted with a special type of gas valve incorporated in the screw cap provided for each cell.

The battery possesses the advantage that no sulphation or self-discharge takes place, and the battery therefore holds its charge over long periods. For this reason in particular, the handlamp is an excellent standby in case of a black-out from a failure of mains supply. The complete battery, fully charged, costs £1 12s. (213)

*The Britannia handlamp.*

## "OO" Gauge Locos and Accessories

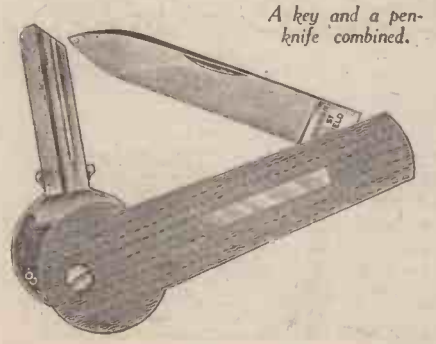
MODEL railway enthusiasts will find many items to interest them in an additional list just issued by Hambling's. Included in the list is a complete 6-volt motor unit, fitted with adjustable bearings, brush gear and driving worm, and ready to fit to the frames of the model loco. The price is 19s. 6d., including worm wheel. Other accessories listed include controllers, various types of wheels, signal parts, station roof brackets, new figures (passengers), high-capacity bogies, and detailed sets of coach parts. Price reductions are given in connection with straight and curved track, and time-table notice boards. New additions to the range of scale locos include the Southern "Lord Nelson" 4-6-0 express, and a fine model of the L.M.S. 2-6-4 suburban tank, 2.500 class. (214)




*A model of the latest L.M.S. suburban Tank which makes an attractive addition to a layout.*

## A Novel Penknife

A PENKNIFE is an extremely useful tool to carry about with one as it has a number of uses. A penknife has now appeared on the market into which one's door key can be fitted. As will be seen from the illustration, all that is necessary is to remove the blank which is supplied with the key by simply removing a screw and inserting your own key in its place, or you can have the blank cut if you so desire. (215)



*A key and a penknife combined.*

## New Methods of Testing Insulators

IT is now possible to test insulators, ebonite and rubber-covered metal parts, as used for electrical and chemical purposes, by means of a device which has recently appeared on the market. Flaws and cracks, however small, are instantly detected by means of the apparatus which is shown on this page. The method has been used by a number of well-known manufacturers and can be considered absolutely reliable. The equipment gives a tension of from 20 to 50,000 volts, and adjustment is provided for varying as required. It can be supplied to operate from A.C. or D.C. or, if required, a battery (216)

## Chemistry Sets

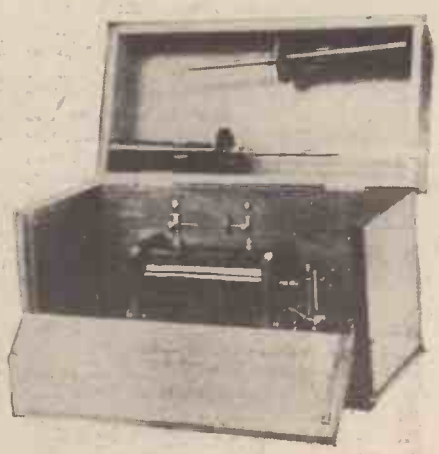
THOSE who dabble in the fascinating hobby of chemistry should inspect the wide range of sets and apparatus stocked by A. N. Beck & Sons. Chemistry sets range in price from 2s. 6d. to 105s., and they have been specially produced to meet the needs of the beginner or the advanced student. A comprehensive list of apparatus and a wide choice of chemicals is obtainable from this firm, so equipment can be chosen to meet your own requirements. All the equipment is of standard quality as used in real laboratories. The list will be sent free of charge. (217)

## Camera Bargains

ALTHOUGH only the really enthusiastic photographers continue their activities throughout the winter, this is the right time for everyone to buy a camera. The summer season has just finished and many firms have a large stock of first-class used cameras and accessories to get rid of before the Christmas rush starts.

One London firm has issued an "End of Season Bargain List," which details literally hundreds of "snips." These are not confined to cameras, orthodox and miniature, but include also photo-electric exposure meters, projectors, enlargers, binoculars and accessories. A feature of these offers is that although they are at bargain prices, customers buying goods over the value of 50s. may take advantage of a confidential hire-purchase scheme.

The same firm issues a really well-produced catalogue-information book of over 300 pages for the price of 1s. This is named "Minitography and Cinetography" and its special feature is numerous, excellent photogravure illustrations. Special articles on choosing a camera, the Leica,



*A useful device for testing insulators and ebonite and rubber covered metal parts.*

the Contax, and the advantages of a miniature camera are some of the many features included. There is a large section on darkroom equipment. (218)

## The "Sirius" High-Speed Model Steam Engine

THE demand for a powerful model twin-cylinder high-speed steam engine has been met by the introduction of the "Sirius," which is intended for use with either an ordinary or flash steam boiler. The weight of the complete engine is 6½ lbs., and on test it developed .4 b.h.p. at 2,800 r.p.m. with a steam pressure of 50 lbs. The engine is a very interesting one to construct, and it can be machined on a 3½-in. lathe. Castings, machined sets, or finished engines are available, and a complete set of castings and materials, including all screws, piston rings, cut gear wheels, and set of drawings, costs 22s. 6d., post free. (219)

## Flexible Shaft Unit

AN interesting device for the workshop is the Batwin Flexible Shaft Unit, which has a hundred and one uses. Polishing, sanding, buffing and drilling are just a few of the time-saving jobs it will do for you—and there are many others.

The power unit is a powerful, specially tested, heavy-duty 1/3rd-h.p. capacitor-start induction-run type motor which, although suitable for light service, is undesirable where frequent starting is required. The over-shaft centre height is 1 ft. 9 in. from the floor and the cast-iron pedestal on which it stands is fitted with a 12-in. tool tray. The Unit, complete with sanding drum, wheel guard and chuck, costs £12. (220)

## A Cycle Speedometer

THE Smith cycle speedometer and mileage recorder is a high-precision instrument that will appeal to all cyclists. It is a fascinating instrument to have on a bicycle, and is very accurate in its speed and mileage recordings. It is available for 24-in., 26-in., or 28-in. wheels, and five different lengths of flexible drive are standard. The price is 19s. 6d. complete, and a miles-per-hour or kilos.-per-hour dial is obtainable. (221)

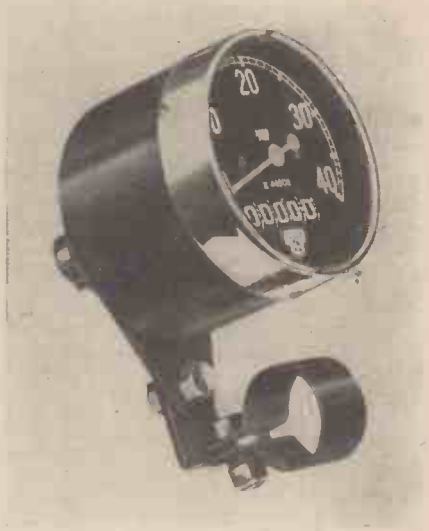
## Tricky Business

AT the Holborn shop of Davenports you will find hundreds of tricks, jokes and novelties—from a complete apparatus that has delighted and mystified audiences, to 3d. and 6d. party jokes and novelties that delight small boys and even older folk too. How would you like to find your cup of tea is red ink instead of orange pekoe? Or when you are offered a delicious-looking chocolate, a tongue of flame shoots out as soon as your fingers touch it? (222)

*A tricky business, but it's simple when you know how.*

## The "London" Lathe

THE "London" 3-in. centre bench lathe, which is of robust construction, will prove a useful adjunct for the home workshop. It has a heavy cast box bed, with suitable webs, to assure the utmost rigidity. The headstock is a solid separate casting provided with a centre fulcrum bolt for set over and two front locking blots, for conveying a hollow mandrel in front, and a phosphor-bronze bush with steel thrust washer and adjusting collar. The back gear is operated by a sliding motion and spring plunger, whilst the tailstock is also a solid casting incorporating a number of features. The length of the saddle which has been designed for rigidity has a long bearing surface on the bed, and is so designed for the entrance of the tailstock that it is an advantage when working on short work between centres. The neat design of the apron carries a double clasp nut operated by an eccentric cam lever. The lathe costs £7 10s. with plain iron bearings and 10s. 6d. extra if fitted with phosphor-bronze bearings. (223)

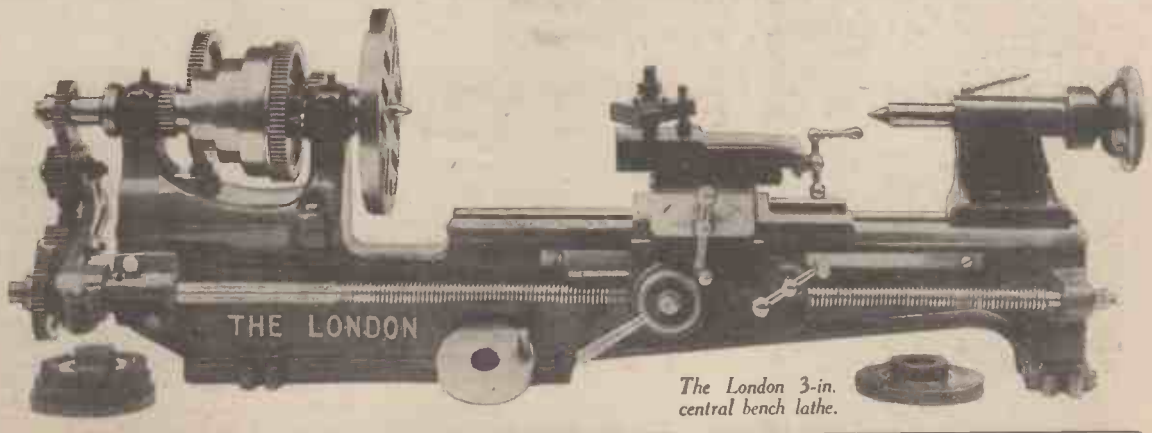


*A Smith's cycle speedometer.*

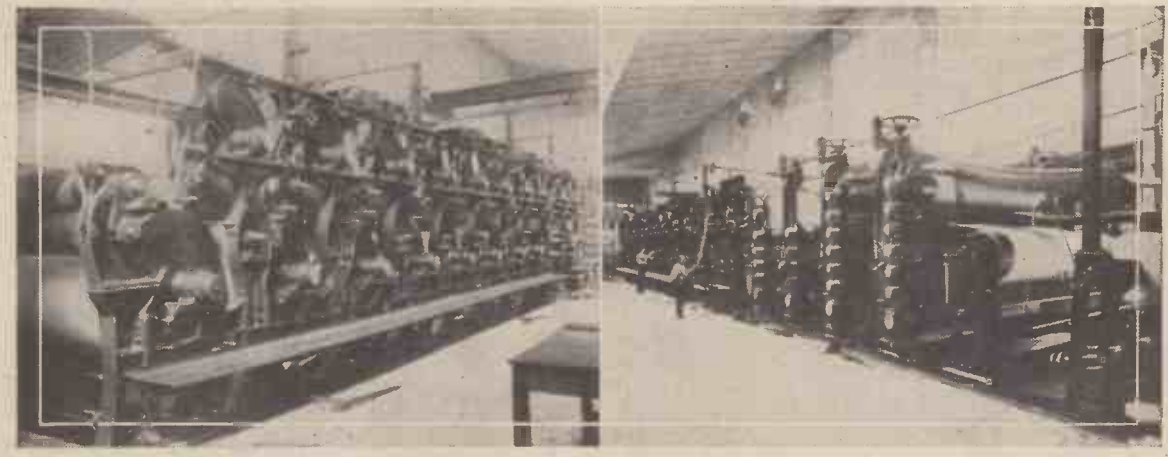
## Cine Projectors

The Amateur Cine Service Ltd., who for many years have been well known at 52, Widmore Road, Bromley, Kent, for all Home Movie needs, are shortly moving to much larger premises at 46, Widmore Road, where the extra space and increased facilities will enable them to receive visitors to their showrooms in even greater comfort.

This month, just in time for Xmas, they are offering particularly keen values in moderately priced projectors, and support this with a very complete film library and the easiest of easy payments. (224)




*The London 3-in. central bench lathe.*



*(Left) One of the powerful paper-making machines used in present day manufacture. (Right) This view of the machine shows the finishing rollers.*

# THE MANUFACTURE OF PAPER

## A Brief History dealing with the first crude attempts at Paper Making up to Present Day Processes.

PAPER in one form or another plays a part in the life of every single one of us. It has become one of the most widely used commodities and a necessity of modern life, and to picture the world in which we live without it is well-nigh impossible. Think of the life of a schoolboy; the books from which he learns, the books on which he writes, paints or draws, are all made of paper. The tradesman books his orders, makes his bills and packs his commodities all with the aid of paper. The medium of all commercial transactions is paper. It is the medium, too, by which news, literature and learning are propagated throughout the world.

But paper is not a product of the modern world. The Egyptians, feeling the need for a medium on which to inscribe their records, prepared a form of paper from a large species of reed called papyrus, from which our English word paper is derived. It is possible that the Chinese were using a material more akin to our paper at an even earlier date. However, with the spread of learning in Western Europe in the fifteenth century a cheaper and more abundant material was looked for, and, during the reign of Queen Elizabeth, paper, made from rags, was first made and used in England. It was not until the beginning of the nineteenth century that any attempts were made to manufacture paper, either in the form of a continuous web or by machines, and at a much later date still that materials other than linen or cotton rags were used.

### Raw Materials of Paper

The raw materials of paper have one common characteristic in that they are all vegetable fibres, that is, fibres derived from some form of plant life. These raw materials are principally three: rags, wood-pulp and esparto grass. Under the heading of rags are included all kinds of linen and cotton rags of many colours and varying degrees of cleanliness, old and worn-out linen collars, remnants from the cuttings of boot linings, and "lintus," a cotton waste left after the extraction of the seed.

Wood pulp is divided into two classes according to whether it is mechanically or chemically prepared. Both classes are prepared from woods of the coniferous (cone-bearing) trees, chiefly spruce, fir and pine, and in the initial stages the preparation is identical. At the pulp mill, the trees are cut into short lengths and the bark is stripped off. For making mechanical pulp, these logs are ground by machines to a fibrous matter, which again undergoes a grinding process in order to reduce it to a finer state. After a drying process these fibres are subjected to hydraulic pressure from which they emerge as sheets of wood pulp. For making chemical wood pulp, the logs are cut into small chips, which are dissolved by sulphur and other solvents in a boiling process. This process also serves to separate resinous and foreign matter from the fibre, with the result that the final product is better than that of the mechanical process.

*The pulp boiler.*

### Esparto Grass

The third raw material is a native grass of Spain and certain parts of North Africa, from where we obtain our supplies. The grass is particularly good as a paper-making material on account of its fibrous nature.

Mills in which paper is made from these materials are widely distributed, but for the most part three factors operate in determining their sites. One determining factor is proximity to the sources of raw materials, and it is this which has led to the building of the paper mills of English and American newspapers in Newfoundland and Eastern Canada where wood pulp for newspaper is easily and abundantly obtained. Another important factor is water, which is required at all stages of manufacture and which, since it is in constant contact with the materials, must possess those characteristics which will produce the best results. Moreover, quantity as well as quality is required; it is estimated that in the manufacture of one ton of paper, eighty thousand gallons of water are employed.

### The Pulp Stage

Let us examine in turn the preparation of each of these raw materials to the "half-made" or pulp stage, that is, the stage when it is ready to pass on to the paper-making machine. When the rags arrive at the mills in large bales they have first to be sorted, a process which envolves the grading of materials, the removal of all foreign matter, such as buttons, hard seams and hooks, and the cutting up of the rags into convenient sizes. The cut-up rags are then conveyed along moving belts to the boilers, and on the way are passed over copper drums which remove and collect all the dust. The dust thus collected is carried away by large suction pipes and used in the manufacture of felt.

In the containers into which the moving belts lead, the rags are boiled at a high temperature in a solution containing caustic soda which extracts all colouring matter, and, so that all the rags shall be equally treated, the boilers revolve slowly during this process. From the boiler the rags pass to an oval vat in which they are thoroughly

washed by the passing through of a continual stream of water, the dirty water being drained out at one end and fresh clean water pumped in at the other. After washing, a "beater" is lowered into the vat to reduce the already fibrous matter to a finer and more uniform state.

The sheets of wood pulp are about three feet square and are first cut up into small pieces by a series of revolving knives, through which the sheets are passed, before passing to the washing and bleaching process.

The esparto grass when it arrives is full of white dust, similar to that found in poor-quality hay, and this has to be removed by a cleaning or dusting process first of all. Then follows a "sorting" process, during which all foreign matter and coarse pieces are picked out by hand as the grass is conveyed along a travelling belt on its way to the boiler.

The pulp of all three materials is now so much alike that it is difficult to determine from which of the three any one specimen has been derived. At this stage colouring

*As the paper passes from its bed of wire mesh, it passes between suction boxes which draw off the remaining water, and receives the impression of its watermark from a revolving dandy roll, one of which is shown on the left.*

matter, if coloured papers are being made, is added and the pulp is "sized" in order to provide the paper with a non-porous surface. The chief "sizing" materials are resin and alum. Some papers are "loaded" also at this stage with mineral clay to make them more opaque or heavier.

When the various mixing processes have been completed, the pulp is diluted and passed on to the bed of the paper machine through a "screen" made of metal with a number of slots which prevent any coarse fibres passing. The solution as it passes the screen is made up of 2 per cent. of fibre and 98 per cent. of water. The bed of the paper machine is made of a very fine wire mesh, through which the water drains and to which a side to side motion is given to help the fibres to settle and interlace. As the paper leaves its bed of wire mesh, it passes between suction boxes which draw off the remaining water, and receives the impression of its watermark from a revolving dandy roll, a fine-gauze skeleton roll on to which is sewn or soldered the copper wire design of the required water-mark. The pressure of the embossed design is sufficient to displace the fibres and to impress permanently the design on to the paper.

# QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 175, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

### ELECTRO-MAGNETS

**"I HAVE a transformer working off 220 v. A.C. mains which gives outputs of 3, 5 and 8 volts at 1 amp. I wish to construct two electro-magnets to work off this, both to be in circuit at same time. Please advise me how to make the magnets with maximum efficiency with the power available.**

YOU cannot make an efficient magnet to work off A.C. because of the chatter. The core must be laminated and we advise you to try the following. Core of soft iron wires, former of thin brass measuring 1½ in. by 1 in. Wind the space full of No. 28 D.C.C. wire and work from five volts.

### ADAPTING A ⅛-h.p. MOTOR

**"I HAVE in my possession a 230-v. ⅛-h.p. series universal vacuum-cleaner motor. It is a two-pole machine and I desire to convert it into a squirrel cage inductor machine to drive a grindstone. If I short-circuit the commutator and apply A.C. at reduced voltage to the fields and rotate it by external means it runs at approximately 250 revs., and the rotor gets very hot. It will run either way without alteration. Can you please tell me what is the reason it will not do, say, 2,800 revs., and why the rotor gets hot, etc., and how could I remedy this?" (E. C., Notts.)**

THE reason for the overheating and slow speed is the armature windings. Strip these and replace with solid copper bars soldered to end rings of greater thickness. The speed on two poles should be 2,300 revs., but the power will not be very great.

### FULMINIC ACID

**"I BELIEVE that fulminic acid is an oxide of cyanogen. Is this correct, and can you tell me how to prepare this acid?" (P. S., Liverpool.)**

FULMINIC acid, C:N.OH, is not an oxide of cyanogen, as you suggest, but, rather, an oxime of carbon monoxide.

The free acid may be obtained by the action of an excess of sulphuric acid upon a rather concentrated solution of potassium fulminate, the free acid being extracted with ether, and the latter being evaporated at ordinary temperatures in a reduced pressure apparatus. If any attempt is made to distil the ether off at normal pressure, the fulminic acid will volatise with the ether and will undergo polymerisation to meta-fulminic acid.

Incidentally, we may remark that the preparation of this acid, and indeed, ALL experiments with fulminates, are very dangerous occupations, since these compounds are frequently spontaneously explosive.

### CARBON TETRACHLORIDE

**"I UNDERSTAND that carbon tetrachloride can be made from methane by changing the hydrogen groups to chlorine groups one by one. Is this so, and could you explain the successive steps, please? Is it possible to add yet another atom of chlorine to form carbon sesquichloride? I think the $CCl_5$ is an explosive. Can you give me any help on this matter?" (J. K., Watford.)**

AN atom of carbon can only combine with four other atoms of groups of atoms. Hence, when a carbon atom is combined with four atoms of chlorine to form carbon tetrachloride, $CCl_4$, its combining power is fully satisfied. There is no such thing as a compound having the formula $CCl_5$.

### AN IMPROVED COWL

**"I HAVE devised a ventilating cowl, and believe the principle on which it functions to be novel. Can I patent this device?" (A. G., London.)**

THE improved cowl, if novel, forms fit subject matter for protection by patent. As there have been a very large number of patents for ventilating cowls, you are advised to make a search amongst prior patent specifications. It is known to utilise a wind current to assist in sucking out foul air, for instance, a conical tube facing the wind and discharging through a trumpet mouth cowl has been employed. Generally, revolving cowls are liable to stick and do not usually respond sufficiently quickly on change of wind direction.

Unless the proposed cowl has greater efficiency than similar known constructions, it is not thought to have any great commercial value.

### MAKING NITROGLYCERINE

**"I INTEND to make some nitroglycerine. I have read several articles about it, but the attempts of several acquaintances have ended in failure. Can you give any practical hints, besides that of not making it? When it is made, how would you recommend detonating it?" (S. T., Dublin.)**

WE cannot give you practical details concerning the preparation of nitroglycerine, since this substance is so dangerous an explosive that the slightest practical error on your part might easily result in a most disastrous and widespread explosion.

Nitroglycerine requires no encouragement to detonation. It will explode on the slightest shock, particularly when it contains traces of acids, and it has even been known to detonate spontaneously.

If you will take our advice, also, you will not attempt to make the chemical substances whose preparation we have outlined above. Such experiments are all highly dangerous ones.

### LATHERLESS SHAVING SOAP

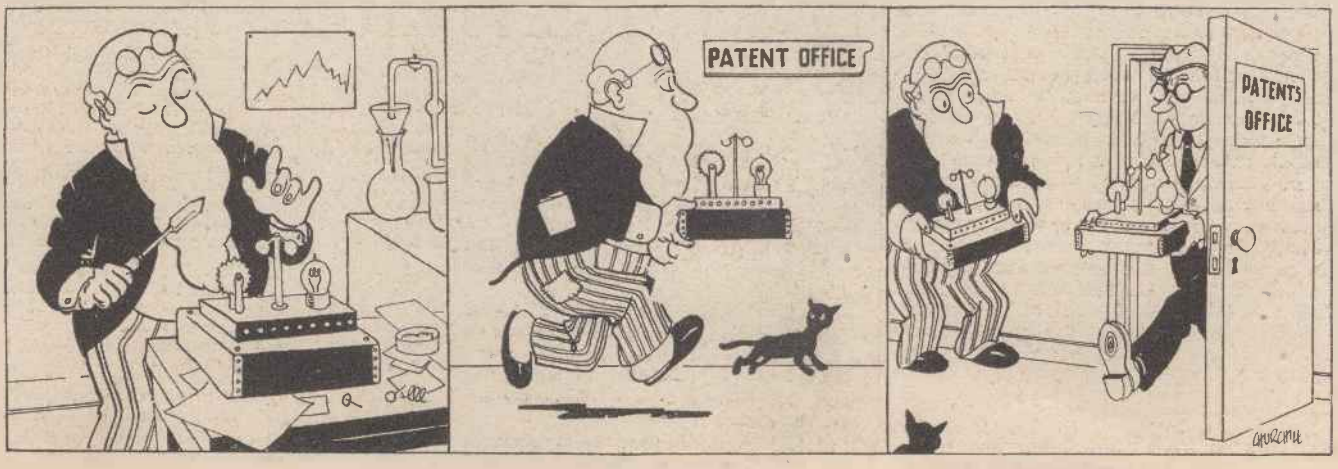
**"I SAW in an American magazine details of a formula for making latherless shaving soap. Mineral oil and glycosterin were the constituents used, but I do not know in what quantity. Can you tell me?" (E. L., Leicester.)**

THERE is no definite chemical compound having the name of "glycosterin." Hence, this must be an American trade-name.

We are not familiar with the name, but we suggest that this "glycosterin" consists of a mixture of sodium stearate or stearic acid and glycerine.

In order to prepare this substance, mix sodium stearate into a thick paste with glycerine. Better mixing will be obtained if the glycerine has about 10 per cent. of water added to it. A very small trace of

## THE PROFESSOR ..... GREAT MINDS . . .



some preservative, such as carbolic acid, should also be added to the mixture.

Sodium stearate is the basic constituent of many shaving preparations and in some instances the free acid—stearic acid—is employed in place of the sodium salt.

## LABORATORY METHODS

**"WOULD you be kind enough to tell me the laboratory methods for the preparation of (1) Diphenylchlorarsine, (2) Brombenzyl cyanide, (3) Lewisite?" (A. L., Swansea.)**

DIPHENYLCHLORARSINE ($C_6H_5$)2.As.Cl, can only be prepared by a difficult and lengthy synthetical process, to describe the precise working details of which would occupy many pages. Hence, we can only indicate to you the successive steps by which this compound is made :—

(*a*) Benzene diazonium chloride is treated with sodium arsenite to form sodium phenylarsenate.

(*b*) Sodium phenylarsenate is treated with hydrochloric acid, forming phenylarsenic acid.

(*c*) Phenylarsenic acid is reduced with sulphur dioxide and water with the formation of phenylarsenious acid.

(*d*) Phenylarsenious acid is treated with sodium hydroxide forming sodium phenylarsenite.

(*e*) Sodium phenylarsenite interacts with benzene diazonium chloride with the production of sodium diphenylarsenite.

(*f*) Sodium diphenylarsenite reacts with dilute hydrochloric acid with the liberation of diphenylarsenic acid.

(*g*) Diphenylarsenic acid is reduced with sulphur dioxide and water to form diphenylarsenious acid.

(*h*) Diphenylarsenious acid, on chlorination with hydrochloric acid, yields diphenylchlorarsine, which is a white crystalline solid, melting at 45 degrees C., insoluble in and decomposed by water.

Brombenzyl Cyanide, $C_6H_5.CH.Br.CN$, which is a yellow-white crystalline substance, melting at 25 degrees C., is produced in three stages, viz. :—

(*a*) Chlorination of toluene to form benzyl chloride.

(*b*) Benzyl chloride is treated with sodium Cyanide in alcoholic solution to form benzyl cyanide.

(*c*) Benzyl cyanide is treated with bromine vapour in direct sunlight to form brombenzyl cyanide.

Lewisite is a complex mixture of chlorvinyldichlorarsines. It is prepared as a dark brown oil which is liable to explode, and is produced in America by a more or less secret process in which acetylene is caused to react with arsenic trichloride in the presence of anhydrous aluminium trichloride.

## INTERNATIONAL PATENTS

**"I AM interested in the procedure for application for International Patents and would be glad of the following information. Where should application be made? The countries which are included in such protection? The cost? Does the date coincide with the date of the British protection, or must application be made for them both together?" (P. B., Manchester.)**

THERE is no such thing as an "International Patent" if by such term is meant a single patent which will give international protection. There is an International Convention for the protection of Industrial Property, whereby any person who has made application for patent in a country which is a party to the Convention has the right, within twelve months from the date of such application, to claim priority of date for applications in respect of the same invention in any other Convention Country.

The following countries are parties to such International Convention :—

Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Ceylon, Cuba, Czecho-Slovakia, Danzig, Denmark, Dominican Republic, Esthonia, Finland, France, Germany, Great Britain, Greece, Hungary, Irish Free State, Italy, Japan, Latvia, Luxembourg, Mexico, Morocco, Netherlands, New Zealand, Norway, Poland, Portugal, Rumania, Spain, Sweden, Switzerland, Syria and Lebanon, Trinidad and Tobago, Tunis, Turkey, Yugo-Slavia, Union of South Africa, United States of America.

Mutual arrangements have also been made between Great Britain on the one hand and India and the Union of South Africa on the other for grant of priority rights similar to the above Convention Countries.

An application for patent in any of the above countries must be made in that country and in the language of the country. It must also comply with the requirements and the laws of the country. In order to obtain the priority date in any of the above countries, the patent application must be made in that country within 12 months from the earliest patent application for the same invention made in any other convention country. For instance, if an applicant has filed an application for patent in Great Britain on the 1st January, 1937, he must apply in the Convention country before the 1st January, 1938, and can then claim the priority date in such country of the 1st January, 1937. It is not possible to give the cost of filing patent applications in each country without having some particulars of the invention which it is desired to protect. As it is imperative in applying for foreign patents to have professional assistance, you are advised to get into touch with Mr. A. M. Flack, Imperial Buildings, Ludgate Circus, E.C.4.

## BURGLAR-PROOF WINDOWS

**"I HAVE invented a new type of window-catch for making windows burglar proof. Should I apply for a patent, and if so, where?" (H.A., Nr. Leeds.)**

THE improved fastener for sliding window sashes is novel from personal knowledge and, if novel, forms fit subject matter for protection by patent. It is not thought, however, to be an article which is likely to be commercially successful in view of the many window-fasteners which have been or are already on the market and which are more cheaply produced and fitted, and as efficacious in practice as the proposed fastener. In view of the probable difficulty in getting a manufacturer to interest himself in the invention, it is not thought to be worth the expense of even protecting it by filing an Application for Patent with a Provisional Specification which is the least expensive way of obtaining protection.

## A CHEAP CEMENT

**"I AM in need of a very cheap cement which will secure steel wire in hollow handles, and have found that a paste made with calcined calcium magnesite and magnesium chloride dissolved in water (hydrometer reading 1220) is suitable, but this cement quickly attacks the steel wire and rusts it.**

**I know for certain that it is possible to prevent this action taking place and shall be glad if you could advise me how the above formula can be modified to absolutely prevent this rusting action taking place." (G. H., Sheffield.)**

THERE is no doubt that the magnesium chloride is responsible for the "rusting"

of the steel, which phenomenon is more of an actual corrosion than an ordinary rusting. There is equally no doubt that the firms who have developed a non-rusting formula using this material are working their process as a secret one (which is frequently the case), since there is no published information on this matter.

You could, of course, inhibit the rusting action by giving the steel articles a coating of celluloid varnish before cementing them in place. Spirit varnish, too, would work equally well.

We understand, however, that you require a non-rusting magnesia cement which can be used with steel articles without the latter having to be treated in any way at all.

In making up the cement, we would advise you to use as strong a solution of magnesium chloride as possible, and only use a very small quantity. Make a thick paste by mixing the magnesium chloride solution with the calcined calcium magnesite (or, alternatively, ordinary calcined magnesia). This cement will dry out quickly, becoming rock hard, and, once dry, no rusting or corrosion should take place.

Another suggestion for eliminating the the rusting is to dissolve the magnesium chloride in a 2 per cent. solution of gelatine, containing a few drops of carbolic acid.

Yours is certainly an interesting problem, but it is one concerning which we can find no published information and we think that its entire solution will only come about after considerable patient trial and experiment on your part. You may be sure, however, that it is the magnesium chloride which is causing the rusting action, for the other ingredient of the cement is more or less inert.

### FINGER-PRINTS

**"I BELIEVE there is a chemical for making finger-prints become visible on a sheet of paper without damaging the writing on the paper. Also can I make these finger-prints permanent?" (J. M., Walsall.)**

FINGER-prints on paper can sometimes be rendered visible by scattering over the paper a little lycopodium powder and then by glancing at the paper in a sideways direction.

At other times, the finger-prints may be rendered visible by immersing the paper in a solution of quinine sulphate and then by examining the paper in sunlight or in light rich in ultra-violet rays. Under such conditions the prints will often show up darkly on a fluorescent background.

One cannot, however, lay down any hard and fast rule for the detection of finger-prints on paper. Each case is very much a law unto itself and must be dealt with individually. There is, therefore, no one powder which will infallibly reveal a finger-print when scattered on to a surface bearing the latter. There is, also, no chemical which will render an ordinary finger-print permanent.

### ELECTROLYSING SEA WATER

**"WHAT can I mix with carbon in order to obtain a paste which would harden after being put into moulds? I wish to use the paste to mould carbon plates for electrolytical cells.**

**"What gas is liberated from the negative pole when sea water is electrolysed? Does this gas or the product when burned in air corrode iron or magnolium?**

**"How can I obtain magnesium chloride from sea salt, and what temperature is necessary to melt sea salt?" (A. L., Bristol.)**

THE only way to mould carbon powder satisfactorily for electrical purposes is to subject it to hydraulic pressure, this being the manner in which carbon rods and plates for batteries, arc lamps, etc., are manufactured. The amateur, having no hydraulic apparatus, has no chance of producing such articles of a satisfactory standard.

If brine of sea water be electrolysed, chlorine will be evolved at the anode and the metal sodium will be liberated at the cathode. The sodium will immediately react with the water to form sodium hydroxide (caustic soda) and hydrogen, which latter will be evolved from the cathode. Thus the net result of this reaction will be: chlorine at the anode and hydrogen at the cathode. At the same time, also, some oxygen will be formed at the anode (if ordinary sea water is used). A portion of this will combine with the chlorine, so that the gaseous product from the anode will comprise chlorine, oxygen and an oxide of chlorine. This gas (or, rather, mixture of gases) is not inflammable. Owing, however, to its chlorine content, it will corrode iron and magnalium severely.

It is not easy to obtain magnesium chloride from ordinary sea salt. Perhaps the best method for you to adopt is to make a concentrated solution of sea salt and add to it a strong solution of sodium carbonate. This will precipitate magnesium carbonate. The precipitate is filtered off, washed and dissolved in dilute hydrochloric acid to form magnesium chloride.

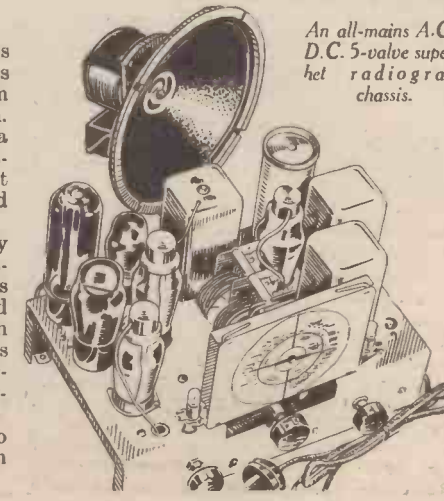
The exact fusion temperature of sea salt varies according to the precise composition of the salt. You can take 730°-750°C. as a fair average fusion temperature for common sea salt. At this temperature, a portion of the salt is actually volatile.

## Remarkable Bargain

For the remarkably low price of 6 guineas it is now possible to obtain an all-mains A.C./D.C. 5-valve superhet radiogram chassis complete with valves and 8-in. moving coil speaker as shown. It has a six-stage circuit with iron-cored I.F. transformer and the pentode valve in the last stage provides over 3 watts undistorted output.

The supply voltage is automatically controlled by a thermal-controlled resistance valve and the size of the chassis is 11 in. by 7½ in. by 8¼ in. The set is supplied complete with a specially matched Celestion speaker having an 8 in. cone, valves, knobs and escutcheon. If desired it can be purchased for 5s. down and 18 monthly payments of 7s. 11d.

The receiver is designed to cover 16 to 2,000 metre wavebands, and is fitted with an easy-to-read station-name illuminated dial



*An all-mains A.C./D.C. 5-valve superhet radiogram chassis.*

# INEXPENSIVE AMPLIFYING SYSTEM

## Peto-Scott Transverse-Current Microphones And Compact A.C. Amplifier

*The neat and compact design of the amplifier.*

PETO-SCOTT CO., LTD. have recently produced a complete amplifying system which is ideal for dances, sports tournaments, etc., as well as for home broadcasting and radiogram reproduction.

It consists of a transverse-current carbon microphone and transformer, a four-valve (including rectifier) amplifier, a field-energised moving coil speaker, 25 ft. of microphone flex (with switch) and 50 ft. of four-way speaker lead. There are two types of microphone available, the professional floorstand microphone at 42s., and the table model at 25s. These microphones can be used in conjunction with any type of amplifier, whilst for home broadcasting it is necessary only to connect them to the pick-up sockets of the ordinary radio set.

Transverse-current type microphones give excellent response at all frequencies. The table microphone assembly is supported on four sensitive springs attached to a chromium plated ring, mounted on a black moulded base.

### The Amplifier

The amplifier is designed for A.C. operations and is built as a neat unit on a grey-enamelled metal chassis. It comprises an input valve feeding into two pentodes in push-pull, and a full-wave rectifier. A combined volume control and on-off switch is provided, whilst there is a two-pin socket for pick-up or microphone and a four-pin socket for the energised speaker. Alternative sockets are provided for mains-voltage adjustment.

On test, the amplifier proved extremely satisfactory, giving an excellent output of good-quality reproduction whether used after a radio receiver, with a pick-up or with the Peto-Scott microphone. The rate of maximum undistorted output is between six and seven watts, so that two or three large speakers can be operated successfully. After finding the more suitable position of the mains plug, background noise was negligible in relation to the output obtainable.

Not only did the microphone and amplifier give good reproduction of speech and singing, but they did justice to various "effects" and "noises off."

The price of the amplifier (Model A.C.67) is £3 10s. cash, or it may be obtained on easy terms by making a first payment of 5s. followed by 11 monthly payments of 6s. 9d. Microphones also can be bought on the easy payment plan by making an initial payment of 2s. 6d.

*The table and stand microphone*

## TOOLMAKING AND TOOL DESIGN

*(Continued from page 126)*

a rigid construction is that illustrated in Fig. 8. Here the top and bottom or bush carrying plates are separated and secured by four or more pillars. At the ends these pillars are shouldered down to pass through holes drilled in the corner of the plates. Hardened steel cap-nuts screw on to the shouldered ends to secure the pillars to the plates and form feet. Needless to say for accurate results the distances between the shoulders on all pillars needs to be exactly maintained as does the overall length of the nuts.

While of simple construction this form of jig will, with certain modifications, serve as a basis for "jigging" many jobs.

This is but one of the many examples of built-up construction, but it is one that is typical of the class in general. Wherever the building-up process is employed reliance should never be placed entirely on the use of slotted head screws. Bolts afford a better medium of securely holding the

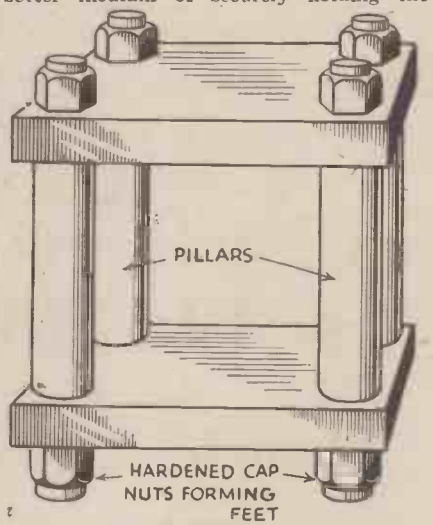



*Fig. 8.—A built-up jig.*

parts together but the disadvantage of such a method is that bulky heads may cause interference. Hollow-head cap screws provide a neat and effective alternative. The heads of these screws are small in comparison to those of bolts and require to be seated into counterbores in the same manner as cheese-head screws but unlike which they can really be tightened. This being so, reliance should never be placed on the screws alone for maintaining the parts of the jig in position, and therefore, all important parts at least should be additionally secured by dowelling.

Jigs of the cast-box type require careful designing with a view to providing sufficient strength without unnecessary addition to the total weight and also as to the ease of machineability of the jig interior.

Actual examples of cast-box jig construction will be given later. One important point relating to jig-feet in general is to see that they are so disposed and of sufficient size not to drop into or foul the table slots or holes in the machine table on which the jig is to be used.

# BUY, EXCHANGE OR SELL

Advertisements are accepted for these columns at 3d. per word (minimum 12 words at 3s.—advertisements of less than 12 words are charged at the minimum rate of 3s.) subject to a discount of 2½% for 6 consecutive monthly insertions or 5% for 12 consecutive monthly insertions. TERMS:—Cash with order. Cheques, Postal Orders, etc., should be made payable to George Newnes, Ltd. *The Proprietors reserve the right to refuse or withdraw advertisements at their discretion.* All advertisements must be received on or before the 5th of the month preceding date of publication and should be addressed to the Advertisement Manager, "Practical Mechanics," George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

## BOOKS

**"HOW TO PATENT AND COMMERCIALIZE YOUR INVENTIONS,"** by D. B. Miller, with preface by Lord Askwith. Obtainable from any bookseller, 2/6 net, or from Sir Isaac Pitman & Sons, Parker Street, Kingsway, London, W.C.2. Post free 2/9.

**WANTED VOLUMES 1 and 2 "PRACTICAL MECHANICS."**—Stevens, Brownwich Lane, Titchfield, Hants.

**CLEARANCE OF CRAFTS,** educational etc. Volumes, List free. Lee, Trinity Walk, Nottingham.

## CANOES

**BOAT AND CANOE.** Kits from 25/-. All types completed craft. Winter Reductions. List stamp. Trade.—Metacraft (P), Christchurch, Hants.

## CINEMATOGRAPHY

**ART CINE FILMS.** Exclusive 9.5 and 16-mm. Free Films to Cine Camera or Projector buyers. All makes. State wants.—P. M. Dane, 64, Stanley Street, Liverpool 1.

**CINEMATOGRAPH FILMS.** Standard Size from 6d. 100 feet. Machines, Accessories. Sample Films 1/- and 2/6 post free. Catalogues free.—"Filmeries," 57 Lancaster Road, Leytonstone, E.11

**MOVIES AT HOME.** How to make your own Cinema Projector. Particulars free.—Moviescope (N), Pear Tree Green, Doddinghurst, Essex.

## ENGINEERING

**A BALL-BEARING ANNOUNCEMENT.** Miniature Ball-Races, 1½ mm. to 30 mm. o/d. Sample of the smallest standard ball-race in the world, under ⅛ in. overall, 2/6 post free. Send 2d. stamp for lists. Dept. P., MINIATURE BEARINGS, LTD., 3 Duke Street, St. James's, S.W.1.

Pupil S. Davey (London)

**WORLD'S GREATEST**

**MUSCLE BUILDING**

*Guarantee*

You are positively Guaranteed Robust Health, Doubled Strength and 10-25" more muscle in 30 days or your money returned in full. The famous 4-in-1 Course consists of four great courses in one, yet costs only 5/- post free. It has been proved (1) the most effective HEALTH and ENERGY system ever devised; (2) It quickly builds NORMAL WEIGHT and VIRILE MANHOOD; (3) It develops a Strong Will rigid SELF-CONTROL; and (4) It includes an amazing SUCCESS and PERSONAL MAGNETISM Course. Complete Course 5/- sent privately. Send for Free 16-page Booklet for men.

**INSTITUTE OF PHYSICAL CULTURE, 28 (M.P.50), Dean Road, London, N.W.2.**

# BLUSHING

**FREE** to all sufferers, particulars of a proved home treatment that quickly removes all embarrassment, and permanently cures blushing and flushing of the face and neck. Enclose stamp to pay postage to Mr. M. Temple (Specialist), "Palace House," 128 Shaftesbury Avenue (2nd Floor), London, W.1. (*Est. 37 years.*)

## MAKE MORE MONEY

£3 to £6 weekly can be earned at home in a wonderful business of your own. No matter where you live you can commence to make money in your spare or whole time. No risk, canvassing or experience required. A wonderful opportunity for anyone wishing to add pounds to their income. Particulars, stamp.

**BALLARD, York House, 12 Hambrook Road, LONDON, S.E.25.**

## ELECTRICAL

A.C. & D.C. Electrical Equipment Repair Specialists. Easco, 18pm, Brixton Road, S.W.9.

**¼-h.p. A.C. MOTORS. REPULSION or CAPACITOR,** All voltages, £2/2/6 each. D.C. £1/2/6. —Johnson Engineering, 86 Great Portland Street, W.1.

**SUPER A.C. MOTORS.** Brand New, 1/10 h.p., 30/-; ¼ h.p., 38/6; ½ h.p., 38/6; ½ h.p., 55/-; larger sizes. Electric Tools, Machines, Pumps, Compressors, etc.—John P. Steel, Clyde Street Mills, Bingley.

**TRANSFORMER BARGAINS** 25 Watt, 10/20/40v. output; 7/6d. INSTRUMENT WIRE 28SWG. D.C.C. 2/2d. per pound. WILKINSON'S, 204, Lower Addiscombe Road, Croydon.

## MEDICAL

**ARTIFICIAL SUNLIGHT,** also INFRA RED RAY and RADIANT HEAT. Inexpensive home apparatus supplied, state requirements. Treatise, advice, hire.—SPECIALIST (Dept. P.M.), 22, Loxham Street, Bolton, Lancashire.

## METAL WORK

**MAKE METAL TOYS.** Easy, profitable with "Success" Moulds. List Free. Complete trial mould 1s. 6d.—Lee's, 1 Birkin Avenue, Nottingham.

# BE TALLER

Your Height increased in 14 days or money back. **3-5 inches** gained, health improved. Guaranteed harmless. Remarkable testimony. Complete course 5/-, or particulars sent free under plain cover:— **L. Stebbing System, 28 (B.O.X.), Dean Road, London, N.W.2.**

## INVENTORS

**VALUABLE GUIDE**

*General Advice Free.* POST FREE 6d.

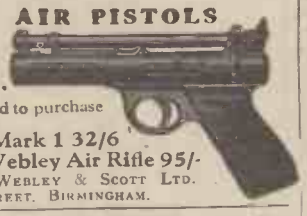
**CHATWIN & CO.** Est. 1880

Regd. Patent, Design and Trade Mark Agents for all countries.

**253 (D) Gray's Inn Road, London, W.C.1.**

**WEBLEY AIR PISTOLS**

**Marvellously accurate for target practice.**

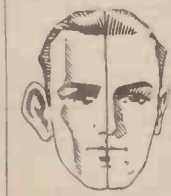


No licence required to purchase or use at home

**Senior 45/-, Mark 1 32/6**

**Junior 21/-, Webley Air Rifle 95/-**

*Write for List.* WEBLEY & SCOTT LTD. 106 WEAMAN STREET, BIRMINGHAM.



**PROTRUDING EARS**

**ORO,** a simple modern method sets them in position immediately. **Invisible—Comfortable—Harmless,** used any time by adults and children. Endorsed by physicians and users as the best method for correcting this disfigurement. Write for free booklet and testimonials to—

M. TRILETY (R 158)
45 Hatton Garden, London, E.C.1.

**OUR ADVICE BUREAU**

**COUPON**

This coupon is available until December 31, 1938, and must be attached to all letters containing queries, together with 3 penny stamps. A stamped addressed envelope must also be enclosed.

PRACTICAL MECHANICS, DEC., 1938.

## MICROSCOPY

**THE MICROSCOPE.** The British Journal of Microscopy and Photomicrography, 1s. monthly. All Newsagents, or 1s. 1d., post free, from The Microscope, 20/21 Took's Court, London, E.C.4.

**MICROSCOPIC OBJECTS**—unmounted, prepared. Assorted packet, 2/-.—Leng, 183 Manchester Drive, Leigh-on-Sea.

## MODEL ENGINES

**AERO ENGINE SETS.**—Baby aero castings as low as 5/9. Tiptop ½ h.p. sets, water or air-cooled 9/9. Charging dynamos, ball-bearing enclosed, from 8 amps., 15/-. Boat propellers, tubes, fittings. Castings made in any metal. Instructive, interesting catalogue 3d. Write—Butler's, Profit-Sharing Works, Wade Street, Littleover, Derby.

## MODEL MAKING

**50/- WEEKLY.** Sparetime making models for us. Particulars, samples 6d.—H. Elliott, Engineers, 17, John Bright Street, Birmingham, 1.

## MONEY-MAKING OPPORTUNITIES

**SALES REPRESENTATIVE** wanted, spare time. 35s. weekly easily made. Richfords, Ltd., 8a, Snow Hill, London.

## MUSICAL INSTRUMENTS

**BAND GUIDE.** Hints on the Bugle, Drum, Flute, Staff Parade formation, etc. Free, post paid.—Potter's (Manufacturers), West Street, London, W.C.2.

## PATENTS

**REGINALD W. BARKER & CO.** (Established 1886), 56 Ludgate Hill, London, E.C.4.—Patent and Trade Mark Booklets Gratis.

# For Work after Dark

Mechanics and owners of small workshops, lathe sheds, observatories, etc., should get the

# TILLEY LANTERN

(Burns ordinary Paraffin)

Light of 300 c.p. for 6 hours for 1d.

Its magnificent light enables work to continue after dark, either in or out of doors. Can be placed anywhere. Made in stout brass, and there are no parts which can rust, corrode, or get out of order. Burns steadily anywhere, unaffected by weather, however severe. Get rid of all antiquated devices, and use this marvellously efficient **All-British** Tilley Storm Lantern. Price 36/-.

**Remit 36/- or can be sent C.O.D. Post and Charges Paid.**

**TILLEY LAMP CO. (Dept. P.M.), HENDON, N.W.4**

You NEED this **"IMPETUS" MOTOR TOOL** an Electric High Speed hand grinder, file, router, etc., that SAVES TIME, EFFORT & EXPENSE. Faster, easier and more accurate. Nothing on the market to touch it at 63/- nett. *Send for detailed specification NOW and be up to the minute.* Super model, £4.

**JOHN P. S. STEEL**
**Clyde Street Mills Bingley.**

# BUY, EXCHANGE OR SELL

## MISCELLANEOUS

**Lab. Microscopes. Xmas Offer, 25/6 ! !** Astounding bargains. Full triple nosepiece revolving objectives; 100, 200, 300 diameters; rack pinion, etc.; as illustrated in last September's issue. Supplied to every profession. Numerous testimonials. Guaranteed. Send 3d. stamps, Photograph List. 30/- Polarizing Attachments, only 12/6 ! ! Clearing Large Students' Compound Microscopes, 200 diameters; rack pinion, etc.; 5/- each ! ! Made in U.S.A.—Below.

**Terrestrial Telescope Lens Outfits, 2/6 ! ! For assembling** 30-in. instrument: 4 cm. diameter objective with day eyepiece in cell with stop; magnification 20 diameters; clear, erect image (equivalent 400 x area). Also suitable for astronomical purposes.—Below.

**Super Midget Telescopes, 1/3 ! !** Fountain Pen size open; triple brass sections; 9-mile range; covered in real leather; 2 for 2/-.—Below.

**Chemicals for Experimental Purposes. Any 12 for** 2/3, 24 for 4/-, carriage paid; List free.—Below.

**Photo-Electric Cell Outfits, 24/9 ! ! Complete with high** and low resistance relays; illustrated instructions and accessories; ready for immediate operation; opens endless experimental field in light ray control; exceptional value.—Below.

**4-Volt A.C./D.C. Electric Motors, 1/- ! !** 6,000 r.p.m. Complete kit of parts, easily assembled, in box with illustrated instructions; 2 for 1/9.—Below.

**Heavy Duty Electric Motors, 4/6 ! !** Universal 3 to 10 volts; 10,000 r.p.m.; exceptionally powerful; develops approx. 1/30th h.p. from 6 volts.—Below.

**Miscellaneous List Free.**—Astro. Telescope Outfits' 5/6; Lens, Microscope Accessories, Electric Motors' X-Ray Tubes, etc.—Below.

**Above, Post Free, C.W.O. C.O.D. 1/- extra. Postage** abroad.—J. K. M. Holmes, Scientific Instrument Dealer, Dept. P.M.7, "Vizcaya," Wolvelelgh, Gosforth, Newcastle-on-Tyne.

**OPTICAL BLACK LACQUER,** dead matt totally non-reflective. 2/- tin, post free.—MEGSON, 21, Western Road, Leigh-on-Sea.

**A 50-TON** stock of Carbons, every size and type, including battery. Low prices. London Electric Firm, Croydon.

**ALUMINIUM FISHING REEL** castings. 3 in. diameter, from 2/3. 4 in. sets pair Hoffman ball races, drawings 7/10 complete.—Francis Woods, 30 Spring Gardens, Bawtry, Doncaster, Yorks.

**SLIGHTLY USED TRIX RAILWAY GOODS,** list 1½d.—Georges, 11 Friars Street, Ipswich.

**TELESCOPES!** Reflecting, refracting. Parts supplied. All classes instrument work undertaken, repaired. Established 50 years.—Irvings', 258 Kingston Road, Teddington.

**LIGHTING SET.** 12 volts, 150 watt, Petrol, W.C. As new. Less Battery. Bargain £6. Hallam, Upton, Poole, Dorset.

**CASTING MOULDS FOR LEAD SOLDIERS,** animals and novelties. Sample mould, 2/9. Catalogue, stamp.—Industries, 2 Waldegrave Park, Twickenham.

**MOTORS FOR MODELS, Etc., 230 v. A.C.**—D.C. 9/- C.P. Transformers 200-250 v. 4-8-12 v. 50c. 1/6 C.P. 45, Banners Street, Cradley, Staffs.

## MODELS

**STEEL TUBING,** Seamless, ¼" to 5¼", 1/32" to ⅛" thick. Please say lengths you cut to. Cotes, Church Walk, Brentford, Middlesex.

**EVERYTHING FOR** electrical rewinds and repairs. Screws, nuts, and washers for model engineers. Lists free.—Lumen Electric Co., Litherland, Liverpool, 21.

**TRIX TWIN TRAINS and COMAN SCALE "OO" RAILWAYS.**—Lists 4d., exchanges, highest allowances. Models purchased.—Georges, 11 Friars Street, Ipswich.

## WATCHMAKING

**WATCH & CLOCK REPAIRERS.** Send 3d. to complete list of material and tools. Blakiston & Co., Ainsdale, Southport.

## WIRELESS

**HEAR AMERICA, AUSTRALIA, JAPAN.** New Receivers with valves, from 19/6. Numerous testimonials. List free.—W. J. Buckle, 63 Avenue Approach, Bury St. Edmunds.

## WOODWORK

**CABINET HARDWOODS,** Oak, Mahogany, Ash. Whitewood, Ply-woods. Lowest Prices. Send Cutting Lists.—Wilfred Parr & Co., March Works, Lancaster Road, Leytonstone, E.11.

## PATENTS AND INVENTIONS

**HAVE YOU** a sound, practical invention for sale, patented or unpatented? If so, write Chartered Institute of American Inventors, Dept. 104, Washington, D.C., U.S.A.

**AMERICA.** Sell your patents through "INVENTION," leading U.S.A. monthly. Specimen copy 2/3, annually, 25/- from British Agents, INTERNATIONAL ENGINEERING CONCESSIONAIRES, LTD., 3 Duke Street, St. James's, S.W.1.

**INTEREST SECURED** for inventions. Send 1½d. stamp for prospectus.—Miller, 7, Ratcliffe Avenue, Ryde, I.O.W.

## PHOTOGRAPHY

**£500** worth, good, cheap Photo Materials, Films, Plates, Cards, Papers, Chemicals, Catalogue and 4 Samples free.—Hackett's Works, July Road Liverpool 6.

**DON'T TAKE RISKS.** Good developers mean good results. Our reliable stock developers keep twelve months after mixing. Satisfaction certain to amateurs and professionals. Best developers ever put on the market. Makes two pints strong developer. 6d. each, 6 for 2/3, 12 for 4/-. Post free.—Hackett's Works July Road, Liverpool 6.

**"PANTOGRAPHS"** make large accurate drawings from small photographs, etc., easily. 1/-.—Cooke 33 Hawthorn Road, Levenshulme, Manchester.

**PHOTOGRAPHIC MATERIALS.** Plates, Films, Mounts, Chemicals, etc. Interesting money-saving lists and samples free.—"Kimber's," 105 Queens Road, Brighton.

## SITUATIONS VACANT

**WANTED, GOOD ELECTRICIAN** for Motor Garage, able to take charge of electrical department. —Apply stating wages and qualifications to Gilbert & Son Ltd., Lincoln.

**G.P.O. ENGINEERING DEPT.** (no experienc required). Commencing £3/13/0 per week. Age 18-23 Excellent prospects. Free details of Entrance Exam from B.I.E.T Dept. 579), 17-19 Stratford Plac London, W.1.

**DRAUGHTSMAN.**- Numerous vacancies available in Electrical, Mechanical, Structural and other Branches of Engineering; Building; G.P.O. etc. for men age 17-40. Exp. unnecessary if willing to learn. Details of openings, salaries, etc. FREE from N.I.E. (Dept 372), Staple Inn Bldgs. W.C.1.

## STAMPS

**STAMPS,** 50 for 6d., 150 for 1s., many British Colonials, try a packet.—D. Brown, 2, West Cromwell Road, London, S.W.5.

## TOOLS

**GRAYSON'S** Glass-boring Outfits and Tube Cutters avoid risk.—Below.

**DRILLS,** Taps, Dies, Files, Chisels and Punches Best quality at keenest prices.—Grayson & Company 200 Campo Lane, Sheffield.

**BRAND NEW POWER TOOLS** of quality. 10 in. Bandsaws, 54/-. Jigsaws, 22/6. Wood Planing Machines, 80/-. Bench Drills, 11/-. Circular Saws, from 25/-. 3 in. S.C. Toolroom Lathes, from £4 10s. New 1 in. Chromium Plated Micrometers, 12/6. Electric Drills, 32/6. Grinders, Spray Plants, Guns, Air Compressors, etc.—John P. Steel, Clyde St. Mills, Bingley.

**MYFORD LATHE SPECIALISTS.** Cash or no deposit terms from 10/- monthly. Immediate deliveries anywhere. List free.—Nuttalls, 20, Albert Street Mansfield.

**2/6 EACH LOT.** 6 of any following: Milling Cutters, Reamers, Slitting Saws, Grinding Wheels, Taper Shank Drills. 5 lots post paid, 12/-.—BROOKS, Milton Street, Sheffield 3.

## TOOLS—*Continued*

**LATHES FOR CASH** or hire purchase, list stamp. Haselgrove, 60, Queen's Road, Battersea, S.W.8.

**Special Offer Best Quality Large Circular Split Dies,** 2" diam. cutting, ½", ⅝", ¾". ⅞", Whit.; ¾" B.S.F.; 1" gas; 1" brass 26; ¼", 20; 31/32", 30 threads. Usual price, 7/6 each; cheap, 2/9 each. Also 2¼" diam., cutting, ⅜", ½", ⅝", 1¼" Whit.; ⅝", ¾", ⅞", 1" B.S.F.; ¾", 1¼" conduit; ¼", ¾" gas. Cost 10/- each; clear 3/6 each. Also 3¼" diam. cutting 1" gas, 5/6 each.—Below.

**Hexagon Die-Nuts,** invaluable to all repair shops. Genuine clearance prices: Whit., B.S.F., S.A.E., U.S.S.; also brass 26 thread, sizes ¼", 5/16", ⅜", 7/16", ½". Usual price, 7/6 set; outstanding value, 2/9 set. Also ⅝", ¾", ⅞", 1", in same threads, 4/- set of four. Any four sets ¼" to 1", 24/-, for thirty-six die-nuts. —Below.

**1,200 Best Quality Taps, Tapers, 2nds, Plugs. ⅜", 9d.;** ½", 1/-; ⅝", 1/3; 1", 1/6, Whit., B.S.F. Also in gas thread, ⅛", 6d.; ¼", 9d.; ⅜", 10d.; ½", 1/-; ¾", 1/3; ⅞", 1/6; 1", 1/9; 1", 2/-.—Below.

**600 Large Fine Thread Taps, ⅜" to 1¼"** diam., 18 to 36 threads. Very handy stock to experimenters, repairers, etc., in useful lots of one dozen assorted taps. Actual value about 30/-; clearing at 5/- per dozen. —Below.

**2,500 Extra Long Taps, ¼" to ½",** in various threads, mostly standard, Whit., B.S.F., etc., 6" to 12" long. Extremely useful for tapping in lathe. Given away at 2/9 dozen. One tap worth this amount.—Below.

**12 Only Ball-bearing Double-ended Grinding Heads,** to take ⅜" bore wheels. Practically new, 15/- each. Six only Stands for same, fitted with rise and fall slide independent each side. Make very good tool and cutter grinders or surface or special grinders. Stands 10/- each, if purchased with grinder.

**20 Dozen Double-ended Saw Files,** 8", 3/-; 9", 3/6; 12", 4/- per dozen. Also 3", 3½", 4", 4½" Saw Files, 2/- dozen; 5", 6", 3/- dozen.—Below.

**700 Pieces Super High-speed Steel,** 1/16" square, hardened ready for use, 3" long. Four pieces, 2/9. The stuff for lathe tools.—Below.

**2/9 any lot. Eight lots £1.**—Below.

⅜" **Toolholder** with four H.S. Tools.

⅜" **Adj. Boring Tool** with H.S. Tool.

¼" **Drill Chuck,** taper or straight shank.

1/16" to 5/16" **Silver Steel,** 13 pieces.

⅜" to ¾" **Silver Steel,** 4 lb., 2" to 4" long.

**500 Ass. Brass and Steel Screws, etc.**

**100 Steel Hex. Bolts and Nuts,** ¼" to ½".

**16 H.S. Drills,** 1/32" to 5/32".

**12 Drills,** 1/16" to ⅜". Carbon.

**Set 1" Dies,** ¼", 5/16", ⅜", 7/16", ½", Whit.

**Ditto, B.S.F.,** 26 threads or S.A.E.

**Set ¼" to ½" Taps,** same as Dies. T.S. or P.

**Slitting Saws,** five 1/32" to 1/8" thick, 1" hole.

**Two dozen Fine and Odd Thread Taps to ⅜".**

**Three dozen Tungsten Hack-Saws to 12".**

**18 Grinding Wheels,** ¼" to 1" diam.

**Three H.S. Tap Fluting Cutters,** 1¼" diam.

**One dozen Ass. Files,** 4" to 12".

**Six Files,** 12" to 16". Note postage terms.

**Dozen Toolmaker's Needle Files,** indispensable.

**Best Carborundum Wheel,** 7" by ½" by ¾" hole.

**200 Springs** to approx. 6" long.

**2½" Split Die Cutting,** ⅜", gas.

**5,000 Dies and Taps to clear.** 1/16" Split Circular Dies, guaranteed quality. Usual price, 10d. to 1/3 each. Sizes 1/8", 5/32", 3/16", 7/32", ¼", 9/32", 5/16", in Whit., B.S.F. 40 thread, 0, 1, 2, 3, 4, 5, 6, B.A., 6d. each, 5/6 dozen. Also Taps to suit, except 40 thread, all sizes, 4d. each, 3/- dozen; 9/32" and 1/16", 6d. each. **Taper, Second or Plugs, Tap Wrenches, Adjustable, 9d.; Die Stocks, 9d.**

**Small Taps,** 7, 8, 9, 10, 11, 12, B.A., 1/16", 3/32", Whit. 6d. each, 5/9 dozen. No dies in these sizes.

**Carborundum Wheels,** 9" diam., 1" wide, 1" hole, 5/-. Also rougher Wheels, 8" by 1½" by 1" hole, 3/9 each. Good pair for general tool use.

**High-Speed End Mills,** ¼", 2/9; ½", 2/-. Straight Shank, ⅜" carbon ditto, 1/9.

**£1 Orders Carriage Paid, except abroad.** Money refunded if not satisfied with any of the above bargains.

**J. BURKE, 30 TRIPPET LANE, SHEFFIELD, 1.**

# Special Christmas Bargains

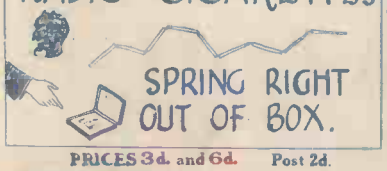
ESTABLISHED OVER FORTY YEARS.
Telephone Holborn 9012.
Cables DEMONTRIXO, London

**Maskelynes Mysteries**

COMPARE OUR PRICES
THEY CHARGE
YOU DOUBLE ELSEWHERE

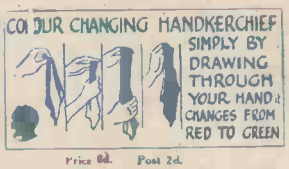
# TRICKS, JOKES & PUZZLES

## RADIO CIGARETTES




PRICES 3d. and 6d. Post 2d.

## COLOUR CHANGING HANDKERCHIEF

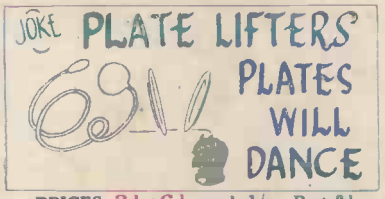



Price 6d. Post 2d.

## Demon Single Handed Billiard Ball Production

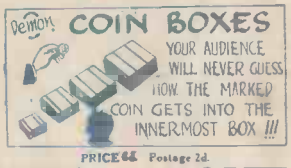

PRICE 9d. Postage 2d.

## JOKE PLATE LIFTERS




PRICES 3d., 6d. and 1/-. Post 2d.

## Demon COIN BOXES




PRICE 6d. Postage 2d.

## The WIZARD'S PACK of CARDS


PRICE 2/6 Postage 2d.

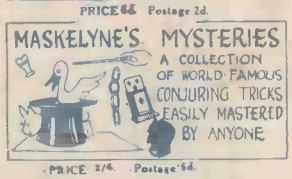
## OLD KING COAL


PRICE 3d. Post 2d.

## LATEST JOKES

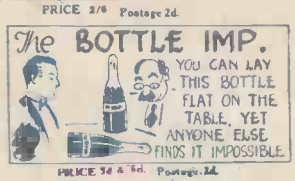
| | |
|---|---|
| Snake Pens .. | 4d. |
| Finger Traps ... | 2d. |
| Broken Egg ... | 3d. |
| Nose Flute ... | 6d. |
| Water Baby ... | 3d. |
| Joke Smelling Bombs, 3 boxes | 6d. |
| Five Amazing Card Tricks ... | 1/0 |
| Sparkling Cigar Joke ... ... | 1/6 |
| Sparkling Match Stand ... | 2/0 |
| Mystery Bells ... | 4½d. |
| Marked Pack of Cards ... | 4/0 |
| Snake Books ... | 4d. |
| Cigarette Box with Snake ... | 3d. |
| Ink Blots, 4 for | 6d. |
| Squirting label Wasp in cost... | 3d. |
| Squirting Dog... | 3d. |
| Squirting Cig.... | 3d. |
| Funny Snake Toilet Box ... | 6d. |
| Snake Pencil ... | 4d. |
| 5 Coin Tricks ... | 2/6 |
| Ventriloquists Throat or Bird Warblers, 12 for | 6d. |
| Flash Paper ... | 6d. |
| Cow Voices ... | 6d. |
| Fish in lump of Sugar, 3 for | 6d. |
| Baby in Lump of Sugar, 2 for | 6d. |
| Non-light Book Matches, 4 for | 6d. |
| Non-light Matches 3 boxes for ... | 6d. |
| Light and go out Matches, 3 for | 6d. |
| Boxes of Funny Jokes | 1/0 |
| Match Jokes ... | 6½d. |

## MASKELYNE'S MYSTERIES




PRICE 2/6. Postage 6d.

## The BOTTLE IMP.




PRICE 3d & 6d. Postage 2d.

## LATEST JOKES

| | |
|---|---|
| Boxes of Match Jokes ... | 1/3 |
| Fire Fun, from | 1/0 |
| MASKELYNES Famous Boxes of Tricks | 2/6, 5/6, and 10/6. |

Postage 6d. each.

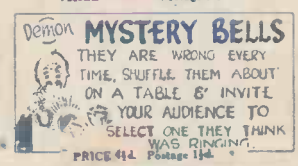
## LUCKY CHARMS

12 Assorted, 1/-

## Demon COIN BOOK


Price 3d. each

## Demon MYSTERY BELLS

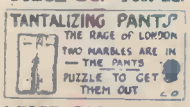



PRICE 4½d. Postage 1½d.

## TANTALIZING COMB

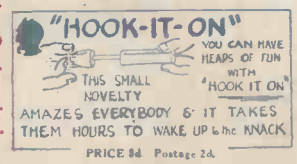

PRICE 4d. Post 2d.

## TANTALIZING PANTS




PRICE 6½d. Post 2d.

## "HOOK-IT-ON"




PRICE 9d Postage 2d.

## JUMPING FLEAS


PRICE 3d. Postage 2d.

## BLACK FACE SOAP


PRICE 4d. Post 2d.

## BOGEY BOGEY


PRICE 6d. Post 2d.

## MUSICAL JOKES

| | |
|---|---|
| Rubber Walnut | 6d. |
| ,, Brazil... | 6d. |
| ,, Biscuits | 6d. |
| ,, Wafers | 6d. |
| ,, Roll ... | 1/0 |
| ,, Cigar ... | 6d. |
| Wizard's Pack of Cards ... ... | 2/6 |
| Imitation Glass of Beer, Best | 1/0 |
| Pea in the Pot Puzzle ... ... | 3d. |
| Snow from Cigarettes ..... ... | 3d. |
| Hot Almonds ... | 4½d. |
| Musical Seats ... | 3d. |
| 3 Card Trick ... | 2d. |
| Soot Cards ... | 2d. |
| ComicBlack Eye Joke ..... | 3d., 6d. |
| Wobbly Cigarette Packet ... | 6d. |
| Window Smashing Joke 6d and | 1/- |
| Mystic Bottles... | 1/6 |
| Floating Flies 4 for ... ... | 6d. |
| Fly Tie Pin ... | 2d. |
| Funny Kinema, squirts water... | 1/- |
| Magic Ball Box | 1/- |
| Magic Pillars ... | 3d. |
| Magic Water ... | 4d. |
| Fly on Sugar, 3 | 6d. |
| Giant Pen ... | 6d. |
| Puzzle Padlock | 4d. |

*Add 2d. Postage on each article. Orders 5/6 post free. Foreign orders extra*

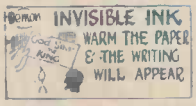
## EXPLOSIVE CIGARETTES


10 for 1/-

## Demon EXPLODING PENCIL

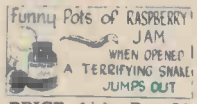

PRICE 6d. Post 2d.

## Demon INVISIBLE INK




PRICE 4d. Post 2d.

## Funny Pots of RASPBERRY JAM




PRICE 4½d. Post 2d.

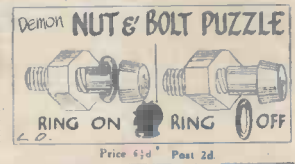
## Demon GRIPIT NOVELTY


PRICE 3d. Post 2d.

## The Vanishing Billiard Ball


PRICE 4d. Postage 2d

## Demon NUT & BOLT PUZZLE




Price 6½d Post 2d.

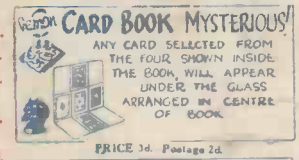
## ALMOST HUMAN MONKEYS


PRICE 1/-. Post 2d.

## JOKE JEWEL CASE

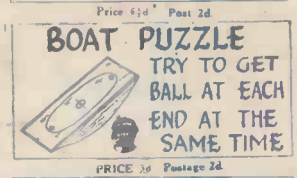
PRICE 6d. Post 2d.

## Demon CARD BOOK MYSTERIOUS




PRICE 3d. Postage 2d.

## BOAT PUZZLE




PRICE 3d Postage 2d.

## CHARLIE CHAPLIN Moustache


PRICE 3d. Post 2d.

## SQUIRTING CIGARETTES


PRICE 3d. Post 2d.

## PIG WITH GROWING TAIL


## WOBBLEY MATCHBOX


PRICE 3d Postage 2d.

## SEBACKROSCOPE

PRICE 4½d. Post 2d.

## WHOOPEE CUSHION


PRICE 9d. Post 2d.

## READING & MAGNIFYING GLASS.


PRICE 6d. Post 2d.

## MERRY WIDOW HANKEY


PRICE 6d. Post 2d.

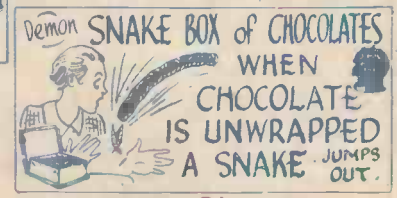
## JOKE DRIBBLE GLASS


PRICE 9d. Post 3d.

## One Pair WASHABLE "WHITE KIDS"


PRICE 2d. Post 2d.

## Demon SNAKE BOX of CHOCOLATES




BOX OF 3, 3d. Post 2d.

★ CATALOGUE and LISTS
56 Pages. Post Free.

**Maskelynes Mysteries**
**204 HIGH HOLBORN**
**LONDON.**

TRADE SUPPLIED.
Send Trade Memo for Wholesale Prices.

Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by THE SUN ENGRAVING CO., LTD., London and Watford. Sole Agents for Australia and New Zealand—Gordon & Gotch, Ltd. Sole Agents for South Africa—Central News Agency, Ltd. Subscription Rates: Inland and Abroad, 7s. 6d. per annum; Canada, 7s. per annum. Registered at the G.P.O for transmission by Canadian Magazine Post.